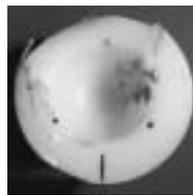
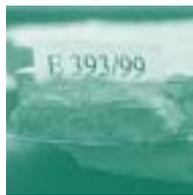
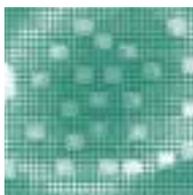


# MONTAN **UNIVERSITÄT** LEOBEN



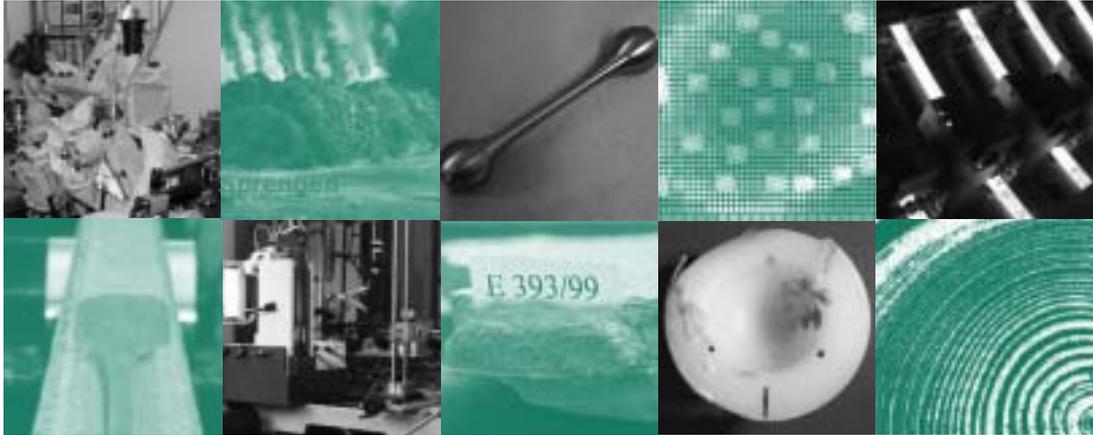
**ANNUAL REPORT 2000**

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The abbreviation  
"MU Leoben" means  
"Montanuniversität Leoben"  
(University of Leoben).

# ANNUAL REPORT 2000



MINING METALLURGY MATERIALS



[WWW.UNILEOBEN.AC.AT](http://WWW.UNILEOBEN.AC.AT)

# Signals of

The year 2000 saw a series of changes which as ignition spark exert sustainable influence on choosing the right direction in the university sector.

## PROLOGUE

The government, which was constituted and attained the ability to work under most difficult conditions, demonstrated to an increasing degree that they not only do the talk but want the quickest implementation. The university reform was implemented without a supporting dialog with the Rector's Conference and the chairmen of

the highest self governing bodies. The resolution of the Council of Ministers in September to introduce tuition fees beginning with the academic year 2001/2002 was too quick of a decision. Universities were also affected by the resolution concerning the budget, especially capital expenditure. For the University of Leoben this led to a cutback of funding by 65% in comparison to the previous year. Thanks to our immense activities in raising income from private sector funding bodies and clients (about 30% of the budget) this did not result in an impairment of our performance possibilities. The University of Leoben is accepted as a center of competence by related industry, therefore MUL succeeded in compensating insufficient state funding by contributions from the private sector at least temporarily.

Our efforts to shorten the study time and to raise the attractiveness of the study mainly concentrated on the new curricula. As a result the academic year 2000/2001 was begun with a new program structure (3 stages of 4, 3 and 3 semesters). The first year of studies is the same for all students, the completion is a requirement for the admission to the courses of the third semester. This "year of preparation and orientation" is a very good possibility of regulating the admission to the study. Now we are able to assure resp. to increase the quality of the education at our university. But most of all we expect a reduction of the average study time.



Foto: Freisinger

# Real Changes

The University of Leoben has always striven to develop and improve and to meet the demands of the labor market. It is not only open to evaluations on national and international level but also tries to find out its positioning within the university sector. In the year 2000 the alumni survey led to essential conclusions which now have a direct impact on our strategy. So it could be stated with satisfaction that the graduates generally evaluated the basic and specialized study as "Good". The demand was raised to improve areas that are no longer in keeping with the times, to increase education in the field of IT and to include more extensive elements of non-technical subjects such as management and social competence. The proportion of self-employed engineers among the alumni is considerable. We can assume that in the future about one fifth of the Leoben graduates will end up as self-employed engineers. It is also interesting that the majority gave no specific details concerning the occupational group. It seems to be obvious that about half of the graduates hold jobs that are not directly related to their subject competence which they acquired in Leoben. This is a clear sign of an occupational flexibility which is based on our sound and comprehensive education.

Unfortunately this positive evaluation of our education met with little response concerning the number of first-year students for the academic year 2000/2001. In comparison to the previous year the number of first-year students dropped by 40%, although the percentage of 29% female students was considerable. The strong drop of

the number of first-year admissions was not only a signal for the university but also a clear sign for economy which is increasingly concerned about the low number of MUL graduates.

The Metallurgy-Forum Austria (MFÖ) expressed its concern spontaneously and supported the development of an overall strategy for the University of Leoben. With the help of a management consultant the University of Leoben succeeded in developing a path breaking strategy which was implemented immediately after it passed the Faculty Senate in November 2000. The "3M" are the core element of the strategy with the main focus on mining, metallurgy and materials. The University of Leoben will not only strengthen its sole position in these fields but will try to further extend its position as international competence center in these core areas. It can be expected that due to cooperation with industry, the linking-up with the international scientific community as well as the already outlined way into autonomy, the University of Leoben will also hold a top position in the competition with other universities in the future.

## PROLOGUE



*Bergrat h.c. Dipl.-Ing. Dr. Wolfgang Pöhl*  
Rector

# Management

## BOARD

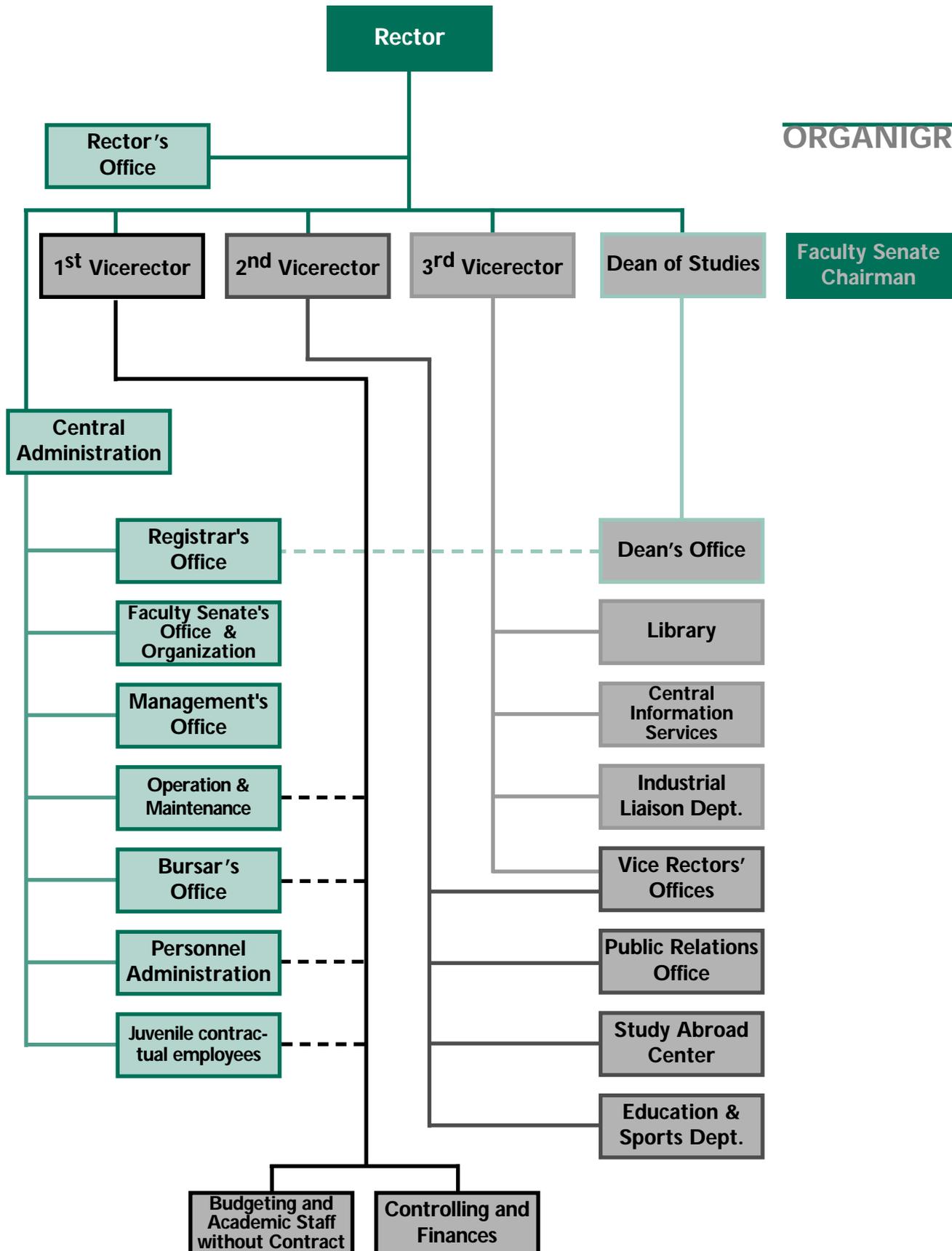


Management Group (f.l.t.r.):  
1<sup>st</sup> Vice Rector Kneissl  
Chairman of Faculty Senate  
Wagner  
Rector Pöhl  
2<sup>nd</sup> Vice Rector Weinhardt  
3<sup>rd</sup> Vice Rector Kuchar  
Dean of Studies Wegscheider

- Rector: Bergrat h.c. Dipl.-Ing. Dr.mont. Wolfgang PÖHL
- 1<sup>st</sup> Vice Rector: O.Univ.-Prof. Dr.mont. Hubert Biedermann (until June 2000)  
O.Univ.-Prof. Dipl.-Ing. Dr.mont. Albert Kneissl (after July 2000)
- 2<sup>nd</sup> Vice Rector: Ao.Univ.-Prof. Dipl.-Ing. Dr.techn. Brigitte WEINHARDT
- 3<sup>rd</sup> Vice Rector: O.Univ.-Prof. Dr.phil. Friedemar KUCHAR
- Dean of Studies: O.Univ.-Prof. Dipl.-Ing. Dr.techn. Wolfhard WEGSCHEIDER
- Vice Deans: O.Univ.-Prof. Mag. et Dr.rer.nat. Robert DANZER  
O.Univ.-Prof. Dr.phil. Fritz EBNER  
O.Univ.-Prof. Dipl.-Ing. Dr.techn. Paul O'LEARY
- Chairman of Faculty Senate:  
O.Univ.-Prof. Dipl.-Ing. Dr.mont. Horst WAGNER
- Deputy Chairman of Faculty Senate:  
Ao.Univ.-Prof. Dr.phil. Oskar THALHAMMER
- Employment Committee Chairman (faculty):  
Ao.Univ.-Prof. Dipl.-Ing. Dr.mont. Anton MAYER
- Employment Committee Chairman (staff):  
Amtsrat Helmuth TSCHOGGL
- Student Union Chairman:  
Florian STEINHART
- Working Committee on Equal Treatment Chairperson:  
Dipl.-Ing. Dr.mont. Tanja LUBE
- University Advisory Board Members:  
Dipl.-Ing. Dr.mont. Hellmut LONGIN (Chairman)  
Dkfm. Dr. Maria SCHAUMAYER  
Bürgermeister Hofrat Dr. Matthias KONRAD  
Hon.-Prof. Dr. Josef KROPIUNIG  
Univ.-Prof. Dr. Wilfried KURZ  
Direktor Mag. Dipl.-Ing. Helmut LANGANGER  
Gewerkschaftsvorsitzender Rudolf NÜRNBERGER  
Dr. Gerold ORTNER  
Generaldirektor Dr. Peter STRAHAMMER  
Hon.-Prof. Dipl.-Ing. Dr.mont. Rudolf STREICHER  
Präsident Dkfm. Dr. Werner TESSMAR-PFOHL  
Mag. Dipl.-Ing. Dr.mont. Rudolf WÜSTRICH

# Organization

## ORGANIGRAM



The University of Leoben was the first university in Austria to develop an overall strategy.

## STRATEGY

Also for educational institutions market-oriented operation is of growing importance. The university reform, which was discussed at length and raised political debate due to the early introduction of tuition fees, and the enormous advertising budget for "Fachhochschulen" have shaken the educational community. The universities were stamped to be rigid and not very dynamic.

The University of Leoben accepts the challenge of increasing competition and developed an overall strategy for the future direction. In this way the University of Leoben has set itself clear goals for the future - far beyond the fragmentary university reform. For the University of Leoben still wants to be leading on the research and education front in the future, to offer attractive conditions for students, to produce excellent graduates and to be a recognized partner of industry.

### A technical university of specific orientation

The University of Leoben manifests its overall strategy in ten principles which describe the qualitative aims of the further development. As named in principle one the University of Leoben claims to be an internationally renowned "Center of Excellence".

The principles declare a strong belief in the unity of research and teaching, a view of teaching in its entirety, in the promotion of alliances, the following of international

standards, partner-orientation, an emphasis on management and marketing principles and in an attractive infrastructure. The principles demonstrate a clear positioning in the scientific community as a technical university of specific orientation

### Triple M

The University of Leoben wants to offer qualitative education and to hold a foremost position in the scientific community in the core areas "Mining, Metallurgy, Materials". The core competencies can be found in the area of the development process from raw material to component/system. Four working groups have set up basic strategies and activities (1. raw materials and geotechnology; 2. elemental substances and materials; 3. process, production and environmental engineering as well as 4. natural science, engineering science and economics).

### Strategic projects

Based on the core area strategies nine strategic projects have been developed so far. These projects demonstrate the intended future positioning of the university. Two of the projects - the metallurgy concept and the material concept - are already being implemented.

### Intensive discussion

The development of the strategy was preceded by a comprehensive discussion. In four working groups, which covered the



# Competition

core areas, representatives of all personnel groups at the University of Leoben have worked out the basic strategic aims and measurements. A steering committee has refined the strategy in a strategy conference under the guidance of the consulting company "Ramsauer & Stürmer Consulting". The Faculty Senate unanimously accepted the strategy on November 22, 2000.

## Stimulus by alumni

The results of the alumni survey in 2000 also influenced the strategy discussion. Essential issues of the strategy such as the increased use of new media in education and the promotion of more marketing courses are the result of suggestions by alumni.

## STRATEGY



Intensive Discussion:  
strategy meeting,  
September 18<sup>th</sup> + 19<sup>th</sup>, 2000  
Photos: Freisinger

## The 10 Strategic Principles

### Principle 1

We are a "Center of Excellence".

### Principle 2

Research and teaching form one unity.

### Principle 3

We view teaching in its entirety.

### Principle 4

"Global Excellence" in research is a corner stone of the University of Leoben.

### Principle 5

Responsibility in research and teaching is an obligation.

### Principle 6

Alliances in research and teaching secure our success.

### Principle 7

International standards guarantee top quality.

### Principle 8

Our university is partner-oriented.

### Principle 9

Management and marketing principles sustainably strengthen the University.

### Principle 10

Attractive infrastructure is a requirement.

The whole strategy document can be downloaded:  
[www.unileoben.ac.at/topics.htm](http://www.unileoben.ac.at/topics.htm)

# Alma Mater

Opposite to the high number of graduations in 2000 there has been a fall in the number of first-year students. Enforced recruitment shall mediate to adolescents that as students of MU Leoben they hold all the trump cards.

## TEACHING

GRADUATIONS						
Field of study	YEAR 1998		YEAR 1999		YEAR 2000	
	Men/ Women	Total	Men/ Women	Total	Men/ Women	Total
Mining Engineering	7 / 2	9	4 / 0	4	9 / 0	9
Mine Surveying	1 / 0	1	1 / 0	1	1 / 1	2
Petroleum Engineering	18 / 2	20	18 / 1	19	11 / 0	11
Petroleum Engineering (ISP)	6 / 0	6	5 / 0	5	7 / 0	7
Metallurgy	12 / 0	12	17 / 0	17	12 / 0	12
Ceramics Engineering	5 / 1	6	5 / 0	5	5 / 1	6
Mechanical Engineering	8 / 0	8	8 / 0	8	8 / 0	8
Materials Science	40 / 4	44	46 / 5	51	32 / 0	32
Plastic Engineering	28 / 6	34	28 / 3	31	28 / 3	31
Applied Geosciences	11 / 2	13	14 / 3	17	8 / 6	14
Industrial Environmental Protection	28 / 2	30	40 / 5	45	55 / 14	69
Other (individual diploma study, petroleum geology etc)	-	-	-	-	-	-
<b>TOTAL:</b>	<b>164 / 19</b>	<b>183</b>	<b>181 / 17</b>	<b>198</b>	<b>176 / 25</b>	<b>201</b>
Percentage of women		10		9		12

**CHART 1:** number of graduations according to fields of study (period: 1.1. to 31.12. of the calendar year)

In the year 2000 201 students graduated and 25 students were awarded a PhD, quite a satisfying number of up-and-coming academics (see to table 1 and 2). A gratifyingly high proportion, 23% of the graduates and 68% of graduates from a doctoral program, passed with distinction.

In line with other universities MU Leoben had to notice a fall in the number of students and a fall in recruitment in 2000 (see to table 3 and 4). The average number of first-year students had been 220 for several years.

As part of the development program of a marketing concept MU Leoben started a

survey among first-year students before the end of the year. This marketing concept has already reached the stage of implementation and aims at increasing the number of students in the following years noticeably. According to the first-year students, the main reason why their friends shunned the MU Leoben was the alleged difficulty of the study program, followed by location problems (distance of Leoben from centers with a high proportion of higher secondary education (Fig 1).

The motives that led first-year students to Leoben are of great importance for the marketing strategy. The main reason why



## DOCTORATES

	YEAR 1998		YEAR 1999		YEAR 2000	
	Men	Women	Men	Women	Men	Women
Austrians	20	-	24	2	21	0
Foreign students	9	-	9	1	3	1
<b>TOTAL:</b>	<b>29</b>		<b>36</b>		<b>25</b>	

**CHART 2:** number of doctorates of Austrian und foreign students (period: 1.1. to 31.12. of the calendar year)

## TEACHING

### REGULAR DEGREE STUDIES AT THE UNIVERSITY OF LEOBEN

	YEAR 1998		YEAR 1999		YEAR 2000	
	Men/ Women	Total	Men/ Women	Total	Men/ Women	Total
Number	2417 399	2816	2365 464	2829	2197 464	2661
Percentage of women:		14		16		18

**CHART 3:** number of enrolments including doctorates, individual diploma programs (without preparatory year, qualifying date: end of registration period of the academic year)

Leoben was first option are the verifiably excellent job prospects, followed by Leoben's reputation as best Austrian university and an intense interest in the degree program (Fig. 2).

Questioned if they could recommend to study at MU Leoben to someone else, 47% of the first-year students answered with an enthused YES. The remaining 53% also agreed, but were struggling to adapt to the demands of a successful study at the time of the survey. The impression that degree programs at Leoben are very difficult must be seen in relative terms because the evaluation of the work load per semester was very positive. After all the curricula and the course contents got the grade "Very Good" by almost 20% and "Good" by almost 40 % of the first-year students. Students also feel very comfortable and sheltered at MU Leoben because the treatment by faculty, staff and older fellow students earned special recognition.

The questionnaires were returned by 36% of the first-year students of the year 2000. The results of the survey demonstrate that the previous track of enforced informational work beyond the Styrian borders has to be followed consequently in the future. High school graduates must be made aware primarily of the uniqueness and sole position of MU Leoben.

The good reputation of the university as one of the best technical universities in the German speaking countries, the unique degree programs ranging from raw material extraction to component/system, the excellent job prospects and the prospects of promotion as well as the very personal guidance and treatment of the students are those unique selling propositions which distinguish MU Leoben as a technical university with a special orientation. These extraordinary qualities will have to be stressed more in the future promotion.

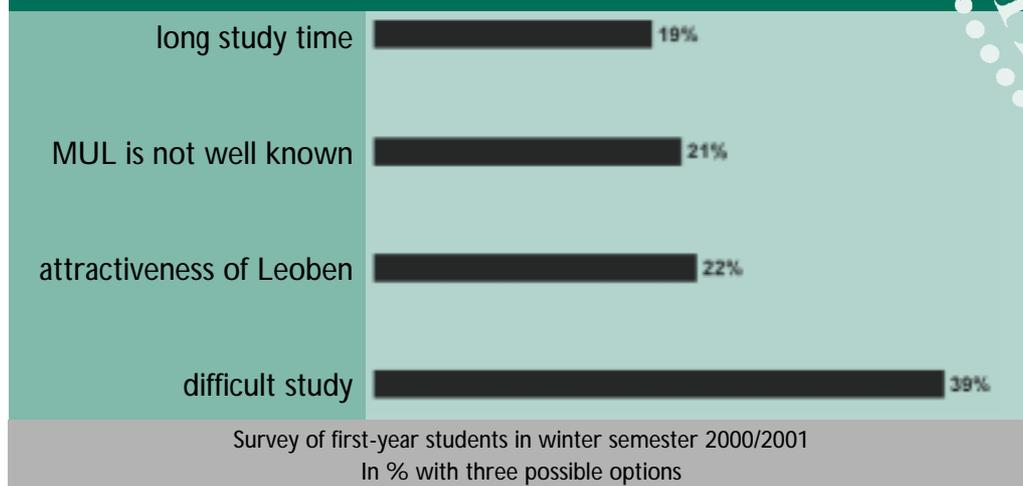
# Further Statistics

## TEACHING

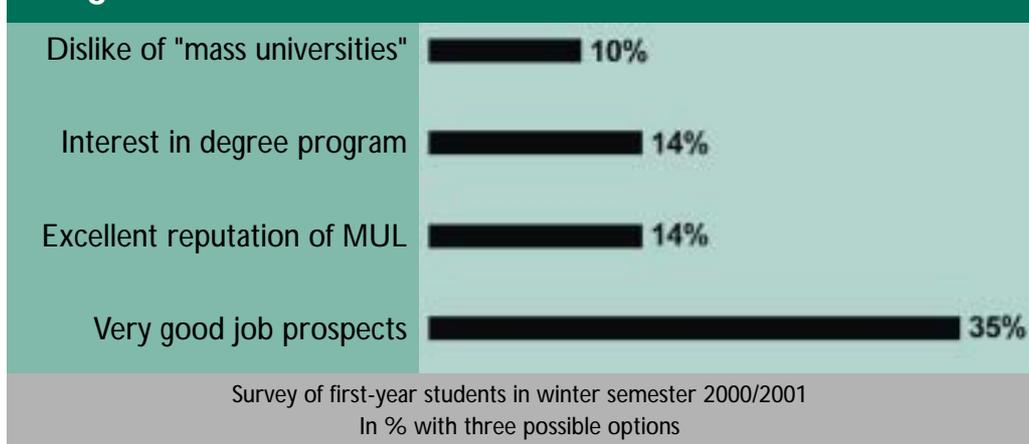
NUMBER OF FIRST-YEAR STUDENTS PER DEGREE PROGRAM						
Field of study	YEAR 1998		YEAR 1999		YEAR 2000	
	Men/ Women	Total	Men/ Women	Total	Men/ Women	Total
Mining Engineering	10 / 1	11	8 / 1	9	4 / 2	6
Mine Surveying	4 / 0	4	4 / 0	4	2 / 1	3
Petroleum Engineering	17 / 7	24	30 / 7	37	-	-
Petroleum Engineering (ISP)	18 / 2	20	26 / 5	31	20 / 2	22
Metallurgy	9 / 0	9	15 / 2	17	25 / 1	26
Ceramics Engineering	10 / 8	18	12 / 4	16	3 / 10	13
Mechanical Engineering	14 / 0	14	14 / 2	16	6 / 1	7
Materials Science	29 / 2	31	30 / 8	38	16 / 5	21
Plastic Engineering	17 / 6	23	26 / 8	34	12 / 5	17
Applied Geosciences	7 / 6	13	11 / 6	17	2 / 4	6
Industrial Environm. Protection	31 / 12	43	23 / 21	44	22 / 14	36
<b>TOTAL</b>	<b>166 / 44</b>	<b>210</b>	<b>199 / 64</b>	<b>263</b>	<b>112 / 45</b>	<b>157</b>
Percentage of women		21		25		29

**CHART 4:** number of first-year students according to degree programs (without preparatory year, qualifying date: end of registration period of the academic year)

**Fig. 1: MAIN REASONS FOR THE INHIBITION TO STUDY AT LEOBEN**

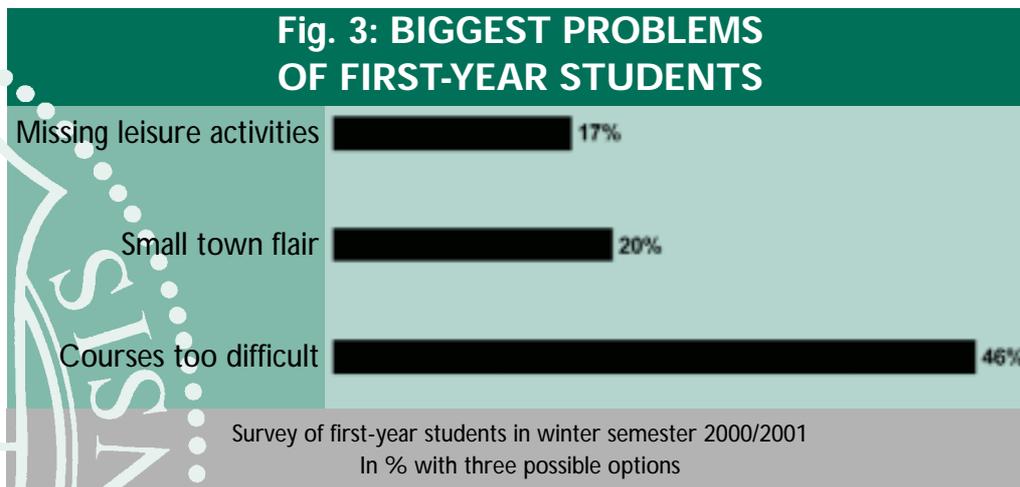


**Fig. 2: MAIN REASONS FOR STUDYING AT LEOBEN**



**TEACHING**

**Fig. 3: BIGGEST PROBLEMS OF FIRST-YEAR STUDENTS**



**PERCENTAGE OF FOREIGN STUDENTS AT REGULAR DEGREE STUDIES**

	YEAR 1998	YEAR 1999	YEAR 2000
EU-countries	82	78	73
Non-EU-countries	181	176	183
<b>TOTAL</b>	<b>263</b>	<b>254</b>	<b>256</b>
% der inscriptions	9	9	10

**CHART 5:** number of inscriptions of foreign students (without preparatory year, qualifying date: end of registration period of the academic year)

**PLACES OF ORIGIN OF THE AUSTRIAN FRESHMEN**

Numbers in %	YEAR 1998	YEAR 1999	YEAR 2000
Styria	54	51	57
Lower Austria	11	12	7
Upper Austria	9	12	15
Carinthia	6	13	5
Vienna	3	4	3
Burgenland	2	3	3
Salzburg	9	3	6
Tyrol	5	1	2
Vorarlberg	1	1	1

**CHART 6:** Distribution of freshman according to provinces (Source: internal questionnaire at registration)

# Life-Long Learning

In the year 2000 the continuing education program of MU Leoben included lectures, workshops and 4 university courses.

## TEACHING

### RANGE OF THE CONTINUING EDUCATION PROGRAM OF THE DEPARTMENTS/SERVICE SECTOR

#### **Environmental, Quality & Generic Management**

Type 3 university courses, degrees: Academic Quality Manager and Master of Advanced Studies in Generic Management  
Organization Department of Economics and Business Management, Department of Waste Disposal and Landfill Technologies (Environmental Management)  
Location University of Leoben  
Duration 3 respectively 4 semesters, block course

#### **Blasting Engineering**

Type University course  
Organization Department of Mining Engineering  
Location University of Leoben  
Duration 8.3. - 17.3.2000

#### **EU-Project TEMPUS/TACIS**

Type University course  
Organization Department of Mining Engineering  
Location Krivoy Rog, Ukraine  
Duration 20.3. - 15.4.2000

#### **Refractory Metals**

Type 20 hour course  
Organization Department of Nonferrous Metallurgy  
Location Moscow State Institute of Steel and Alloys (MISIS)  
Duration 10. - 14.4.2000

#### **Materials Science and Basics of Tools, Processing and Mechanical Engineering for Injection Moulding**

Type Seminar  
Organization Department of Plastics Processing  
Location St. Michael ob Bleiburg, Carinthia  
Duration 11. - 12.5., 25. - 26.5. und 8. - 9.6. 2000

#### **Polymer Lab Indonesia**

Type External Training  
Organization Department of Materials Science and Testing of Plastics  
Location University of Leoben  
Duration 30. - 31.5.2000

#### **Rare Metals**

Type 12 hour course  
Organization Department of Nonferrous Metallurgy  
Location University of Freiberg, Germany  
Duration June 2000

#### **Environmental Management and Technology**

Type Series of seminars  
Organization Industrial Liaison Department  
Location Technology Transfer Center Leoben (TTZ)  
Duration Summer semester 2000

#### **Tunnel Fire**

Type Workshop  
Organization Christian-Doppler-Laboratory for Applied Computational Thermofluidynamics  
Location University of Leoben  
Duration 12.12.2000

# No Practical Relevance without Fundamentals

The majority of the research projects are implementation-oriented in their approach. As before the University of Leoben stands by its traditional obligation of close collaboration with the industrial environment. But also fundamental research is a fixed part in Leoben.

## RESEARCH

The table below lists the number of research projects which were completed in the framework of the partial legal capacity of the departments at MU Leoben in the year 2000. In total the income raised from contractual work amounts to almost ATS 96 million (nearly 7million). The year 2000 has been even more successful than the year 1999 (ATS 67.7 million, 4.9 million) even though the result of 1999 was already ATS 2.3 million ( 167,000) above the average amount of the years 1996 to 1998.

The presentation of all projects carried out in 2000 would go beyond the scope of this report. The following presentation of some projects does not diminish the scientific importance of the others at all. This year's selection of 11 projects wants to

prove that:

1. Just as ever scientists at MU Leoben do research concerning problem solutions for the industrial environment with unbroken energy.
2. In spite of mostly application-oriented research fundamental research does not play a marginal role. MU Leoben is conscious of the fact that the way for a successful technical innovation is paved by prior fundamental research.
3. In research MU Leoben has already left the path of only mining-oriented topics. Researchers at Leoben know how to pay contributions to progress in medical technology, semiconductor technology, timber industry, simulation technology and others on the basis of sciences taught in Leoben.

### RESEARCH PROJECTS AT UNIVERSITY OF LEOBEN completed in the year 2000

Type of the project	EU	FWF	FFF	Christian-Doppler-Laboratories	Federal Government, provinces, communities	Other customers/sponsors
Number	11	12	9	22	37	335

TOTAL: 426

**EU:** European Union  
**FWF:** Austrian Science Fund (Fonds zur Förderung der wissenschaftlichen Forschung)  
**FFF:** Industrial Research Promotion Fund (Forschungsförderungsfonds für die gewerbliche Wirtschaft)

# Network to Success

The Division of Mathematics and Statistics is participating in an Austrian wide special branch of research ("Forschungsschwerpunkt") of the FWF.

## PROJECTS

An algorithm is a method which leads to the solution of problems (mostly of a mathematical or information technological nature) in clearly defined singular steps.

The study of properties of algorithms therefore is an important task in various branches of mathematics and computer science. The design of new and efficient algorithms must be based on sound theoretic principles, algorithms in application have to undergo an evaluation in terms of their behavior (execution time, storage requirements etc.).

The Department of Mathematics at the TU Graz is the partner of the mathematicians from Leoben within the project "Algorithmic Diophantine Problems". Diophantine equations are equations whose solutions have to be determined in the set of integers. This does not only concern the aspect of theoretical solubility of such equations but also the estimation of the number of solutions and the problem of the effective computability, i.e. algorithmic questions. The mathematical approach to these questions very quickly leads to totally different mathematical fields such as the theory of orthogonal polynomials, combinatorial analysis or the investigation of so-called elliptical curves. The network of Leoben and other FSP participants has a very profitable effect on the treatment of these questions. First significant results have already been achieved, the following publications should be mentioned exemplarily: Yu. F. Bilu, B. Brindza, P. Kirschenhofer, A. Pinter and R. F. Tichy: Diophantine Equations and Bernoulli polynomials (with an appendix by A. Schinzel), to appear in *Compositio Mathematica*.

Considering the fact that the Division of Mathematics and Statistics has to provide the education in mathematical fundamentals for engineering students at Leoben and that the up-and-coming academics have to be recruited primarily from outside, the integration in this network can be regarded as a special success for the University of Leoben.

$$\sum_{n=0}^{\infty} B_n(x) \frac{t^n}{n!} = \frac{te^{xt}}{e^t - 1};$$
$$B_n(x) = x^n - \frac{n}{2}x^{n-1} + \frac{n(n-1)}{12}x^{n-2} + \dots;$$
$$B'_{n+1}(x) = (n+1)B_n(x);$$
$$B_n(x) = (-1)^n B_n(1-x);$$
$$f(x+1) - f(x) = nx^{n-1}$$
$$\Leftrightarrow f(x) = B_n(x) + \text{const.}$$

Bernoulli polynomials - an important mathematical instrument

(Ill.: Division of Mathematics and Statistics)

## Importance for Cryptology

Participating in the FWF special branch of research "Number-Theoretic Algorithms and their Applications", the Division of Mathematics and Statistics at the Department of Mathematics and Applied Geometry follows a long tradition of the Austrian mathematical community. Number-theoretic algorithms have recently become of growing importance in various branches of applied mathematics such as cryptology (protection of data transfer against external access), financial mathematics or high-dimension numerical integration. This specific field of research (Forschungsschwerpunkt FSP) should combine the know-how of many Austrian university departments and the Austrian Academy of Sciences.

# Nanometer Microscopy

A new non-optical microscopy technique developed at the Department of Physics facilitates an improved production control in microelectronic industry

In cooperation with semiconductor industry, the Department of Physics applies Atomic-Force Microscopy for nanometer scale investigations. This non-optical microscopy technique with ultra-sharp tips allows to study nanometer structures in microelectronic devices.

Silicon gate oxide is, according to its well known properties and the easiness of processing, the leading material for the production of insulating layers in modern semiconductor industries. According to the demand for higher computing powers and more efficient computer memory modules, a steady reduction of the structure size for the chip production is necessary. This reduction also implicates a decrease of the layer thickness for the silicon oxide films. The oxides used for today's production technology have already reached a layer thickness below 4 nm. A further reduction to values as low as 1nm and even below is planned. Thus, the standard methods used in the microelectronic industry for the characterization of such oxides are driven closer and closer to their limits.

To provide further techniques for the study of silicon gate oxides an atomic-force microscope (AFM), which was originally developed for the mapping of surfaces, was adequately modified. This modification, called "Conducting atomic-force microscopy" (C-AFM), provides the possibility to study very thin silicon gate oxides with high lateral resolution. The dielectric breakdown strength, the homogeneity of oxide thickness and the distribution of defects can be investigated on the nanometer scale.

The measurement of the dielectric breakdown strength with this high lateral resolution provides the possibility for

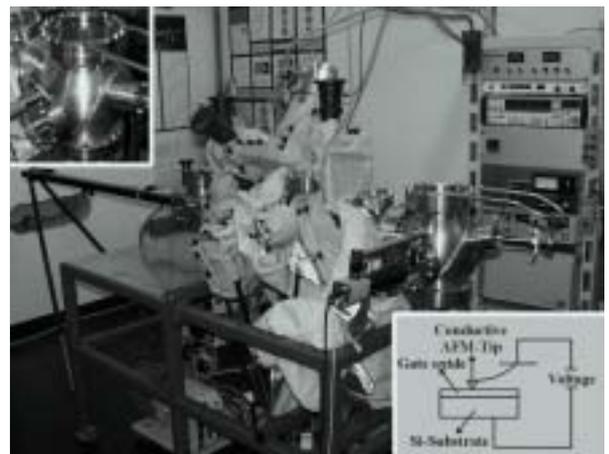
checking the quality of the pure oxide by excluding the influence of impurities. In contrast, the macroscopic methods used in today's standard analysis of silicon gate oxides are usually influenced by such impurities and therefore rarely provide the possibility to gain information about the properties of the pure oxide.

Additionally to the determination of the dielectric breakdown strength, C-AFM has the potential of determining the oxide thickness with sub-nanometer resolution. This information is indispensable for modern semiconductor industry, because for very thin oxides already slight variations in the thickness can lead to a failure of microelectronic devices.

The distribution of defects, as for example metal impurities, in the gate oxides is another very important factor for the long term stability of a device. In this respect C-AFM is a helpful tool for the localization of such defects on the nanometer scale.

The cooperation with Austria Micro Systems (Unterpremstätten), Infineon Technologies (Villach) and Wacker Siltroic (Burghausen/BRD) made it possible to set up a characterization technique which has the potential of a future implementation in the process control. The project was financially supported by the Austrian Federal Ministry of Education, Science and Culture.

## PROJECTS



Ultra-high vacuum equipment for conducting atomic-force experiments. Insert: Upper left: measurement chamber Lower right: scheme for C-AFM measurements

(Photo: Department of Physics)

# Quarry Blasting

The EU-research project "Blast Control" aims at the optimization of quarry blasting. The increased use of high technology will contribute to that attempt.

## PROJECTS

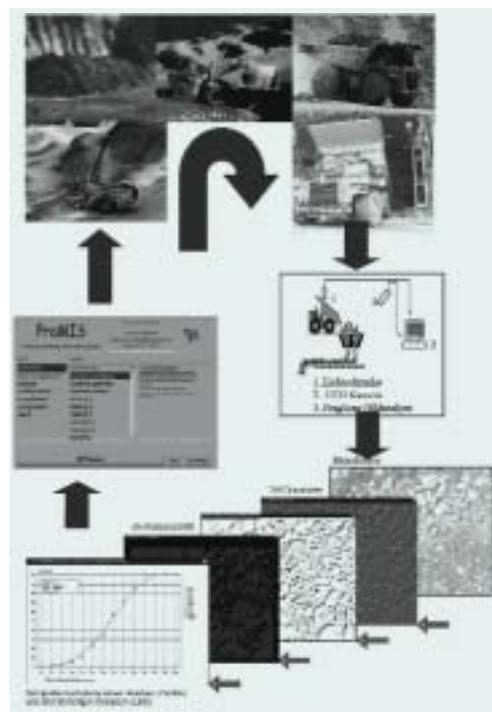
The grain size distribution plays an increasingly important role in the production process of a quarry because the quality requirements on the run-of-mine material concerning the grain size distribution grow and the demand for certain product qualities is constantly rising. On the one hand the grain size distribution determines the costs of loading, conveying and crushing at a quarry to a large degree, on the other hand it significantly influences the aptitude of the run-of-mine material for the applicability in the following production processes.

Since 1998 the Department of Mining Engineering aims at the optimization of blasting in quarries by means of the increased use of high technology in the EU-research project "Blast Control". In cooperation with the explosive/detonation fuse producer "Nitro-Bickford" (France), the

dolomite quarry "Dolomies de Marches Les Dames" (Belgium), the limestone quarry "Cantera de Alzo" (Spain) and the Ecole de Mines de Paris, CGES (France) an integrated control system for the registration of the production process in quarries was designed. This is the basis for the coordination of the blasting procedure with an optimization of the overall profitability of the quarry as the exploitation expenses on the one hand and the profit from the sale of the products on the other hand should result in maximized total proceeds. The project had a financial volume of approximately 30 million ATS (about 2,18 million ).

### Fully automatic measuring devices

A series of fully automatic measuring devices for the control of the production process was installed at the two quarries participating in this project. The loading and conveying process, the measurement of the grain size distribution of the blasted material, the processes in the primary crusher and the production energy were registered. All these data were mainly captured online in the quarry data base ProMIS developed at the Department of Mining Engineering and are the basis for the analysis of the correlation between rock condition-blasting and the quality of the blasting result. In the near future the resulting knowledge will lead to a change in blasting engineering respectively to selective mining in order to obtain certain grain size distributions.



The data base ProMis is the basis of blasting optimization  
(Photo: Mining Engineering Department)

# Strong but Still Tough

It was proved for the first time at the Department of Physical Metallurgy and Materials Testing that statements on the mechanical behavior under tension stress are also possible for tool steels of high strength.

So far it was hardly possible to characterize hard and brittle materials because of their strength and strain properties in tension tests. Such materials have a significant degree of scatter of mechanical parameters. Additionally even minor errors at processing and clamping of the sample influence the measurement results. Up to now strength parameters of hard and brittle materials were usually determined in bending tests of a larger amount of samples and the measurement results were evaluated statistically.

In the framework of a research project of the Materials Center Leoben (client: Böhler Edelstahl Ltd Kapfenberg) a special tension test for tool steels of high strength was developed and successfully tested at the Department of Physical Metallurgy and Materials Testing. A stress distribution in the sample independent of the clamping is guaranteed by the development of a new ball-and-socket head. The geometry of the samples was optimized with the help of the finite element method (FEM). The sample processing with the help of CNC-processing machines is economical, actually a quite important factor regarding the applicability of the method in practice.

## High strength - appropriate toughness

The already completed measurements of various tool steels of high strength demonstrate that mechanical parameters of these materials can be determined quickly and are reproducible with this new method. Contrary to the bending test practiced so

far, now also ultimate strain, strength properties and strain hardening properties can be determined. This facilitates an increasingly reliable evaluation of the mechanical properties of hardened tool steels. Therefore this tension test could be of importance for the development of new tool steels - combining the properties high strength and appropriate toughness.

It is also worth mentioning that the work for this project was done in the framework of a diploma thesis. This is the best evidence for the quality of the education in the field of studies Materials Science.

## PROJECTS



Tension test for tool steels of high strength

(Photo: Department of Physical Metallurgy and Materials Testing)



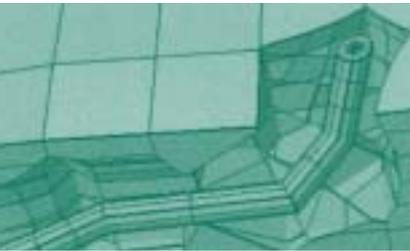
Stress distribution in the tension test

(Photo: Department of Physical Metallurgy and Materials Testing)

# Window to the Future

The Department of Petroleum Engineering developed a path breaking model for numeric reservoir simulation: the windowing technique.

## PROJECTS



Grid generation facilitates the exact graph of the borehole drift.

(Graph: Department of Reservoir Engineering)

Numeric reservoir simulation is the core of modern petroleum business. Difficult decisions worth billions of dollars are based on it. The simulation of production and injection wells is of special importance in this respect. In conventional programs an analytical model is being used which is more than twenty years old. It is qualified by a low number of calculations and high stability but in many respects it does not meet the current requirements any more because this old model neither simulates the area surrounding the wellbore nor does it facilitate a precise prediction of the well flow pressure.

The research of the former Department of Reservoir Engineering, now part of the Department of Petroleum Engineering, concentrates on the design of an alternative model under the guidance of the Department Head Prof. Heinemann. The result is the so-called "Windowing Technique". This technique facilitates a grid around the well which in comparison to the other model is strongly refined and adapted to the fluid flow. In conventional simulators a narrow grid around the well would lead to a drastic increase of the time necessary for the calculation and would question the cost effectiveness of the simulation. The attempt to increase the meaningfulness of a simulation significantly only makes sense when the solution process of the refined area is separated from the solution process of the coarse grid farther away from the well and when different time steps for both areas are applied. All of this

applies to the "Windowing Technique".

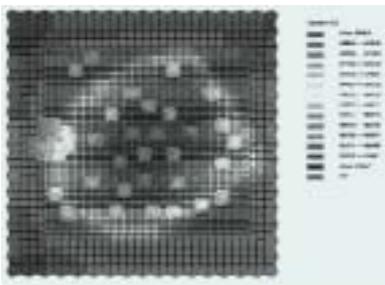
The latest remarkable success of the "Windowing Technique" is its application for the display of all large simulation model wells. Although the number of necessary calculations was only slightly increased this resulted in an enormously qualitative improvement of the simulated results.

### Enormous echo from industry

Practical importance is demonstrated by the enormous echo from international petroleum industry. The "Windowing Technique" was already integrated in the simulator S.U.R.E.<sup>TM</sup>. S.U.R.E. was designed in close cooperation by the former Department of Reservoir Engineering and the HOT (RC)<sup>2</sup> group. In the meantime this software belongs to the leading commercially available products on the subject of reservoir simulation worldwide. Currently another important partner of the department in research of the further development of S.U.R.E. is the seismic combine VERITAS DGC in Houston.

In the year 2001 the results of the "Windowing Technique" will be presented to competent scientists and experts from all over the world on important conferences in Houston and Calgary.

The "Windowing Technique" is the topic of current diploma theses of the postgraduates MLACNIK and HARRER: These members of the academic staff at the department do research in the field of grid generation for the refined area as well as dynamic simulation.



Graph of all wells in the field

(Graph: Department of Reservoir Engineering)

# In Perfect Condition

The optimization of cooling patterns for continuous casting is the main target for project work at the Department of Ferrous Metallurgy.

Since 1999 the Department of Ferrous Metallurgy takes part in the ECSC-program "New Secondary Cooling Patterns for Continuous Casting of Peritectic and Micro-Alloyed Steel". The partners are VOEST-ALPINE Stahl Donawitz GmbH, Corus (Great Britain), CRM (Centre de Recherches Métallurgiques, Belgium) and ProfilARBED (Luxembourg). The Department of Ferrous Metallurgy does subcontracted work for VA Stahl Donawitz.

In the continuous casting of steel, a thin steel shell solidifies in a water-cooled copper mould. The steel shell surrounds the liquid steel pool, and is withdrawn from the mould. Below the mould, the surface of the strand is cooled by means of spray water or a so-called air-mist cooling. The cooling intensity (cooling patterns) is one of the most important casting parameters and has to be adjusted to the cast steel grade and the caster performance, in order to prevent any crack formation at the surface of the cast product, and to guarantee the necessary heat removal. Several steel grades, e.g. peritectic steels (these are steels with round about 0.1 % C) and microalloyed steels are particularly sensitive.

## Optimization

The optimization of the cooling patterns demands an exact knowledge of the features of the strand at the entry of the mould and the beginning of the secondary cooling zone. Besides the analysis of the mechanical properties of the shell (strength, crack sensitivity), the computa-

tion of temperature at the surface and the effective shell thickness are the main targets for the project work of the Department of Ferrous Metallurgy.

The results so far show, that in the casting of round blooms, the cooling conditions in the mould play an important role. Uneven cooling conditions, which are typical for the peritectic steel grades (formation of surface depressions), lead to temperature differences of round about 100 K at the surface, and a shell thickness varying more than 20 % at the bottom end of the mould. The common procedure of one-dimensional heat transfer calculations under idealized conditions as basis for the optimization of cooling patterns is thus made uncertain.

The research program will be finished in 2002, a comprehensive report will be published at that time.

## PROJECTS



In the casting of round blooms problems already arise at the formation of the shell

(Photos: Department of Ferrous Metallurgy)

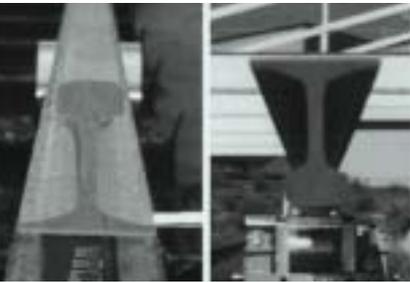


Continuous casting of steel

# Straight into the Future

A new process to define the curvature of rails was developed at the Department of Plastic Deformation and Plant Machinery.

## PROJECTS

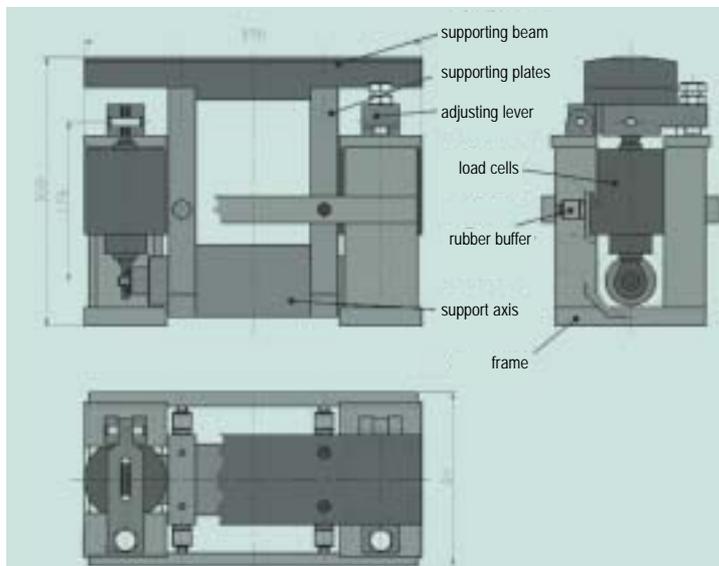


Rails are measured  
(Photos: Department of Plastic Deformation and Plant Machinery)

After rolling long products such as rails and beams are cooled on a cooling bed. During that process they bend. The following straightening is meant to reduce the curvature without influencing other product properties in a negative way. Since up to now there are no appropriate measurement systems for the registration of long products curvature, straightening still is done mainly "by eye". As a result the straightening is not always optimal. The bending back and forth of long products in the straightening machine should be as "subtle" as possible in order to avoid high residual stresses, but it has to be "strong" enough to even out the existing curvatures.

The currently applied systems for the determination of straightness totally neglect the impact of dead weight on curvature. Long products tend to be very flexible and adjust to the contour of their underneath. That long products are curved and do not meet the demands on straightness can only be discovered when they are cut into short pieces.

Force measurement device



## The new development

The weight compensated shape of long products can only be determined by the "curvature balance" (Krümmungswaage) developed at the Department of Plastic Deformation and Plant Machinery. The weight reaction of long products to their contour underneath must be determined before the weight can be corrected. An average long product curvature is then determined. The necessary exact force measurement technique and the minimization of measurement errors were facilitated by the construction and design of appropriate supports.

The measurement results of the curvature balance can further on be used for the control of the straightening machine. Straight long products with low residual stresses can be produced that way.

If operators of straightening machines use the optimization of the straightening process applying the curvature balance then a quality improvement concerning better straightness and low residual stresses of rails and beams is guaranteed. As a convenient side effect the mass of the long products which were produced can be determined exactly.

The presented project was worked out in the framework of a doctoral thesis and the result was published:

Wollendorfer G.: Die Krümmungswaage - Ein neuartiges Messverfahren zum Bestimmen der Geradheit von Langgut, VDI Verlag, Düsseldorf, 2000, ISBN 3-18-385608-5.

# Innovative Electrolysis

The high-current electrolysis developed at the Department of Nonferrous Metallurgy promises to become an innovation for the third millennium.

It depends on the basic material which process will be applied for the extraction of copper. In the case of oxidic and low-sulfidic ores this is a hydrometallurgical process with the help of electrolysis. At present this procedure is applied for about 20% of the world copper production.

The use of electricity is an enormous cost factor. The productivity increase of electrolysis-businesses is the primary goal, comprehensive research is being done worldwide. Also at the Department of Nonferrous Metallurgy the topic of a four year research project was the demand that an electrolysis-business is expected to produce as much copper of high purity and with smooth surface as possible at low energy consumption. The team of the Department of Nonferrous Metallurgy of Professor Peter Paschen and Dr. Andreas Filzwieser cooperated with Professor Klaus Hein, retired professor of the TU-Freiburg and an internationally renowned academic expert.

## Simulation of velocity distribution

The performance of an electrochemical reactor substantially depends on the flow conditions which influence the mass transfer conditions within the relevant phase respectively at the phase boundaries. More copper per time and plant unit can only be achieved if the current density and the electrolyte flow are increased. Based on the data maintained experimentally physical and mathematical models for the near-cathode electrolyte flow could be set up. In the framework of a cooperation with the Department of Nonferrous Metallurgy

and High-Purity Materials in Freiburg the flow field of a copper extraction electrolysis could be measured. With the help of the software package FIRE<sup>®</sup>, in which the set up mathematical models were integrated, the velocity distribution within an electrolysis cell could be simulated. The resulting knowledge could be applied at the copper-high-current-extraction electrolysis with bipolar electrodes. In this case the end electrodes are connected with the circuit whereas the electrodes in between have no contact to the line bar. This series connection results in the bipolarity of the inter-electrodes, i.e. their surfaces are polarized differently. The reduction of the energy consumption is a considerable advantage of this electrode arrangement. Experimental tests with an external imposed gas stirring demonstrated that the copper deposition at a current density of 1000 A/m<sup>2</sup> shows a specific power demand of less than 2000 kWh/t. In consideration of the currently industrially applied technical current density this test result means that the productivity of an electrolysis-business is increased threefold.

The available test results met with positive response nationally as well as internationally. The Department of Nonferrous Metallurgy has already found a partner for a definite industrial project in Andritz-Ruthner Surface Technologies. Further on the Department is negotiating with the Montanwerke Brixlegg and also with MetalEurop-Nordenham concerning an implementation of the knowledge on hand.

## PROJECTS



Laser probe and test cell  
(Photos: Department of Nonferrous Metallurgy)



Result of a  
FIRE<sup>®</sup>-Simulation

# Plaster on the Testbed

The Department of Ceramics Engineering came up with new conclusions concerning the reasons for construction deficiencies caused by building materials.

## PROJECTS

Construction deficiencies caused by building materials result in economic losses which in Austria alone amount to billions. Damages of facades which are caused by large-area separations of the base rendering due to the loss of the adhesive strength are most conspicuous (Fig. 1). Frequently these already occur after 5-10 years. The investigation of the reason for such damages and in consequence also their avoidance help to improve building materials. In the years 1999 and 2000 the Christian Doppler Laboratory for Building Materials with Optimized Properties at the Department of Ceramics Engineering in cooperation with the Austrian Heraklith GmbH carried out investigations which mainly focused on the adhesion of the base rendering to wood-wool boards.

One of the hypotheses concerning the loss of adhesion of plaster was sulfate corrosion of its binding. Sulfate ions can be set free when the binder of the wood-wool board is affected by humidity, or can originate from acidic rain. Long-term tests disproved this assumption.

Contrary to this the hypothesis that cyclic strains of temperature and humidity

affect the adhesion of the plaster to the wood-wool board was confirmed. A finite-element-modelling demonstrated that inadequate adhesive strengths of plasters indeed lead to progressive crack formation which after a few years may result in an extensive loss of adhesion. An example for the simulation of such a crack formation is given in Fig. 2.

To find the reasons for insufficient adhesion a variety of commercial plasters was studied with regard to their relevant properties. Disadvantageous plaster properties were defined and the current results allow to predict the adherence to wood-wool boards.

Since customary building boards differ in structure and bonding agent, varying adhesive strengths may occur even in combination with the same plaster. External factors can raise the probability of damage. An early drying of the plaster caused by high temperatures and wind during rendering multiplies the negative effects of certain plaster properties.

Thus the current results lead to guidelines for reliable performance of rendering which comprise product selection as well as processing.

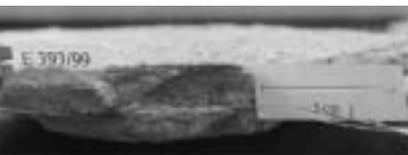


Fig. 1: Typical failure showing plaster separated from the facade

(Photo: Department of Ceramics)

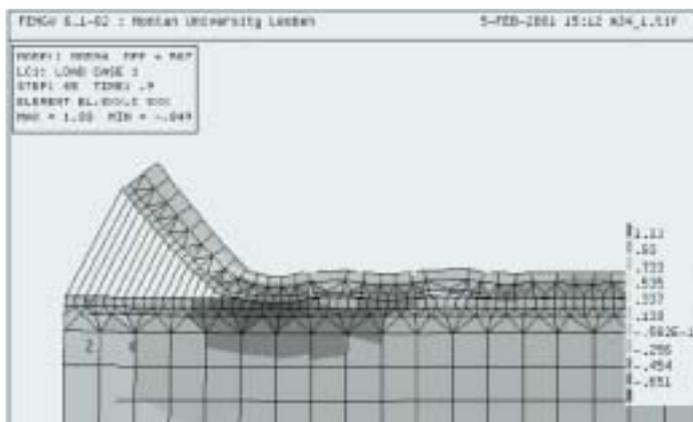


Fig. 2: Finite-element-modelling of crack formation in the interface wood-wool board/plaster under cyclical variation of temperature

# Hip Joints with Longevity

The longevity of hip and joint endoprostheses could be tripled due to research at the Department of Chemistry of Polymeric Materials

Approximately 1.2 million/a of hip and knee endoprostheses are implanted using mainly ultra-high molecular weight polyethylene (UHMW-PE) for articulating surface. Many older people thus maintain their mobility.

The durability of such endoprostheses is usually limited from 10 to 15 years since oxidation of UHMW-PE in the human body may lead to its embrittlement which causes an increase of wear. The UHMW-PE debris often leads to an inflammation in the surrounding tissue and even to osteolysis.

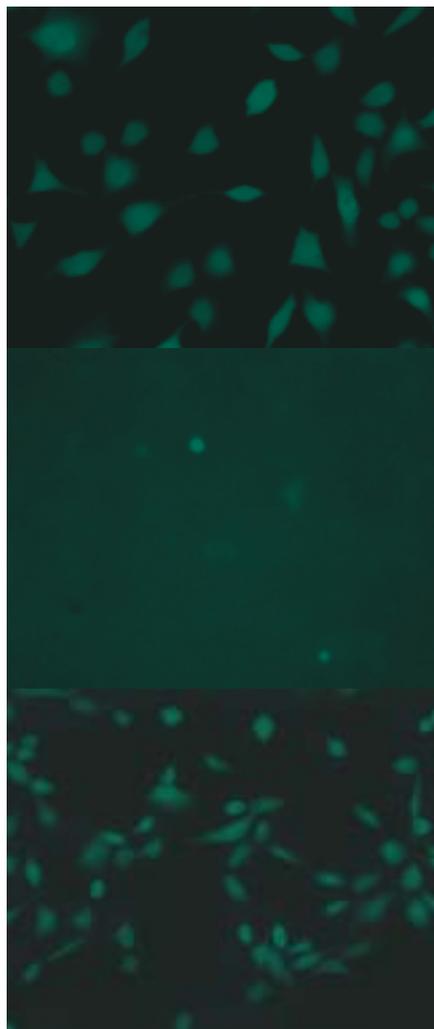
The oxidation of polyethylene is a well known phenomenon in polymer engineering. Usually, a considerable increase of durability of parts made of plastics is accomplished by the addition of stabilizers, so called antioxidants. However, the application of the usual stabilizers in the human body is prohibited due to their toxic action. UHMW-PE for endoprostheses has therefore always been used without stabilizer.

## Learning from nature

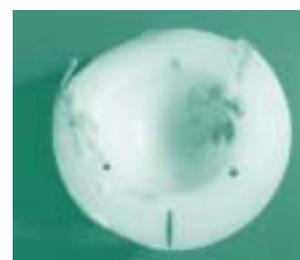
Several vitamins, especially the lipophilic  $\alpha$ -tocopherol (vitamin E) show strong anti-oxidative action. In cooperation with SULZER ORTHOPEDICS LDT, the usability of  $\alpha$ -tocopherol as a stabilizer for UHMW-PE was investigated. Specimens of UHMW-PE stabilized with  $\alpha$ -tocopherol were produced under the same conditions as UHMW-PE hip inserts and were subsequently treated with oxidizing media

for accelerated aging.

The stabilization with  $\alpha$ -tocopherol led to a prolongation of the durability by a factor of three with the potential to avoid re-operations of damaged endoprostheses. The products formed from  $\alpha$ -tocopherol during the manufacturing of PE-inserts (sintering and sterilization by  $\gamma$ -irradiation) were tested for cyto- and genotoxicity (cooperation with RTWH Aachen) and gave no indication for detrimental action.



## PROJECTS



Oxidized and damaged UHMW-PE hip insert

Growth of fibroblast cells on bio-film (top), Polyvinyl chloride with toxic additives (middle), UHMW-PE test insert with  $\alpha$ -tocopherol (bottom)

(Photos: Department of Chemistry of Polymeric Materials)

# On the Track of Nature

The mechanisms of strength and fracture strain of wood are examined at the Department of Metal Physics.

## PROJECTS

Wood can be considered as a cellular material as well as a fiber reinforced composite. In simplified terms wood consists of parallel hollow cylinders (wood cells, see illustration 1). The structure of the cell walls is ultimately optimized according to the different functions in the living tree. Adaptation to various mechanical demands is achieved by varying the thickness of the cell wall layers and their structure as well as composition.

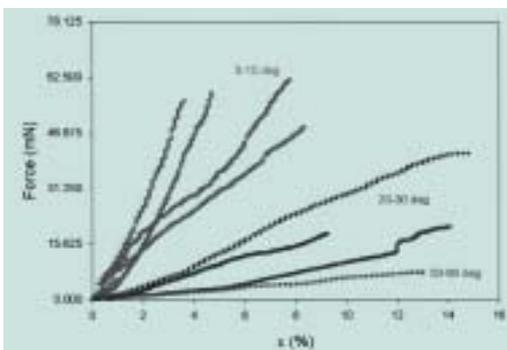


Illustration 2: Force-strain curves of single spruce cells (*Pinus abies*). The numbers refer to the corresponding range of micro fibril-angles (I. Burgert, J. Keckes, K. Fröhmann, P. Fratzl and S. E. Tschegg, submitted for publication in *Plant Biology* (2001)).

Together with the Erich Schmid Institute of Materials Science of the Austrian Academy of Sciences, a working group at the Department of Metal Physics belongs to the researchers who are tracing the mechanisms of strength and fracture strain of wood in numerous examinations. In the framework of the FWF (Austrian Science Foundation) project P14332-PHY "Structure and Mechanical Properties of Wood" the working group from Leoben in cooperation with the University for

Agricultural Sciences in Vienna was the first one ever to succeed in carrying out tension experiments with single wood cells (spruce) with a tension device designed only for that purpose. Cells from different regions were examined in the tree (e.g. cells from early wood, late wood and others). In the preliminary stages of these examinations the micro-fibril angles in the cell walls were determined with X-ray diffraction (XRD). Micro-fibrils are microscopically small structural units of organic material (cellulose). Illustration 2 shows the force-strain curves of the several measurements. These experiments demonstrate that stiffness and strength of the cells decreases when the micro fibril angle gets larger, whereas the fracture strain rises.

## Mechanical properties of wood

Examinations of cells of different kinds of trees offer the possibility to answer questions concerning different mechanical properties of the wood-type on the level of single cells. The experimental approach will include in-situ tensile tests of single wood cells using X-ray diffraction with synchrotron radiation.

The results of this research project also demonstrate that the spectrum of scientific activities is constantly expanded at the University of Leoben.

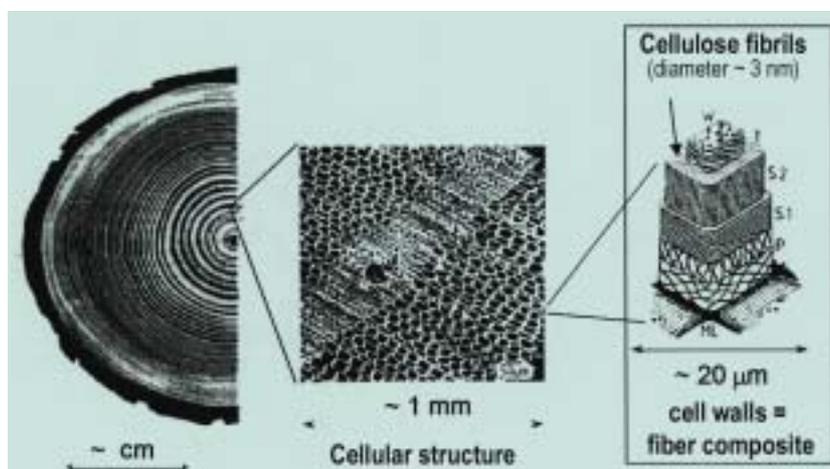


Illustration 1: The hierarchical structure of wood (spruce)

(Illustrations: Department of Metal Physics)

# Networks

Networking - a keyword of our decade - has been applied by the MU Leoben for a long time. For approximately 20 years bilateral agreements have existed between the German technical universities Clausthal and Bergakademie Freiberg as well as the University Miskolc in Hungary. 10 years ago the first agreement with the Colorado School of Mines, Golden, USA was signed, which - due to its great success in student exchange - was extended on a broader basis.

These agreements with the aim of fostering science and research (joint projects, exchange of scientists) as well as teaching (mainly student exchange) were and will be carried on on the basis of cooperating institutions.

In addition to that numerous departments of the MU Leoben demonstrated initiative of their own and initiated close connections to related institutions all around the globe. In the preceding years many universities have joined within the framework of the EU-programs (SOKRATES, TEMPUS and so on), so that a listing of all active cooperations is impossible. Therefore only those cooperation agreements with universities and research institutions are listed below which were signed in 2000.

## UNIVERSITY COOPERATIONS

<p>Mining Engineering Department  <b>Ecole des Mines, Mining Engineering Department (F),            Blasting Research Institute SVEBEFO (S)</b>            Extended cooperation in blasting research</p>	<p><b>Signatory institution            Partner</b></p> <p><b>Field of cooperation</b></p>
<p><b>Ecole des Mines, Mining Engineering Department (F)            with support of the Austrian-French Amadeus Cooperation</b>            "DBF - Dynamic Blast Fragmentation"</p>	<p><b>Partner</b></p> <p><b>Field of cooperation</b></p>
<p>Geophysics Department  <b>University Zaragoza (E)</b>            "Thrust kinematics in the Southern Pyrenean Internal Sierras"</p>	<p><b>Signatory institution            Partner</b></p> <p><b>Field of cooperation</b></p>
<p><b>Univ. Liverpool, Univ. of East Anglia, Univ. Utrecht, Univ. München, Univ.            Rom, Univ. Aix en Provene, Univ. Madrid</b>            "Network for Mineral Magnetic Studies of Enviromental Problems" (MAG-NET)</p>	<p><b>Partner</b></p> <p><b>Field of cooperation</b></p>
<p><b>Academy of Science, Prague</b>            "Control of degradation performance of in-situ remediation techniques"</p>	<p><b>Partner</b></p> <p><b>Field of cooperation</b></p>

# Cooperation with Universities and Research Institutions (continued)

## UNIVERSITY COOPERATIONS

<b>Signatory institution</b>	Nonferrous Metallurgy Department
<b>Partner</b>	<b>University Saarbrücken, Germany</b>
<b>Field of cooperation</b>	"Analytical Chemistry in Tungsten Metallurgy"
<b>Partner</b>	<b>Polytechnic Karlsruhe, Germany</b>
<b>Field of cooperation</b>	"Recovery of Noble Metals from Electronics Scrap"
<b>Partner</b>	<b>Moscow State Institute of Steel and Alloys (MISIS) Russia</b>
<b>Field of cooperation</b>	Fused-Salt Electrolysis of Refractory Metals under Consideration of Niob"
<b>Signatory institution</b>	Physics Department
<b>Partner</b>	<b>High Magnetic Field Laboratory CNRS, Grenoble</b>
<b>Field of cooperation</b>	"Magnetotransport in Wide Parabolic Quantum Wells" "Metal-Insulator transition in PbTe short period nipi-structures"
<b>Partner</b>	<b>University Hamburg, Delft University of Technology, University Genova, University Napoli, Institutuo Ciencia de Materials, Madrid, MPI of Solid-State Research Stuttgart, University Hannover, Hitachi Cambridge Lab</b>
<b>Field of cooperation</b>	EU - TMR Network Project "Quantum Electron Transport in the Frequency and Time Domains"
<b>Signatory institution</b>	Physical Chemistry Department
<b>Partner</b>	<b>University of Technology, Schweden</b>
<b>Field of cooperation</b>	"Creation of a Thermodynamic Database for Inorganic Nickel Compounds"
<b>Partner</b>	<b>University of Wales, Cardiff, UK</b>
<b>Field of cooperation</b>	"Chemical Speciation and its Relationship to Biomedical Problems"
<b>Partner</b>	<b>University Karlsruhe, Vrij Universiteit Brussels, Institut Macromol. Chemistry, Academy of Science of the Czech Rep. Res. Lab. of Materials and Environ. Chemistry, CRC Hungar. Acad. of Science, University Toronto, University Helsinki, Sea Marconi Technologies di Vander Tumiatty S.A.S., AHT Analgebau-Hochtemperaturtechnik, Brabender OHG</b>
<b>Field of cooperation</b>	"Process integrated thermal treatment of halogens containing materials as source for halogens free furls for steel production and residues for noble metal recovery"
<b>Signatory institution</b>	Plastic Deformation and Plant Machinery Department
<b>Partner</b>	<b>Department of Metal Forming FM TU Kosice, Slovakia</b>
<b>Field of cooperation</b>	"Numerical simulation in forming processes" teaching and research

# New Impetus

Following a tradition the MU Leoben establishes close contact with economy. The spectrum ranges from "minor" expert reports to major research contracts. Since there are so many cooperations between departments of MU Leoben and economy and industry, the list is restricted to those cooperations with a contract extent beyond ATS 500,000 ( 36,337) in the year 2000.

A total of 37 projects which are mentioned below belongs to this category. Eleven of the cooperating companies have their headquarters in Styria, a clear indication for the impetus given to the direct industrial environment by MU Leoben. Three foreign companies are also mentioned that assigned research contracts of a larger extent to MU Leoben.

## COOPERATIONS

<p><b>MECHANICAL ENGINEERING</b>            ELETRONA Rottenmanner Kabeltechnik GmbH, Styria            "Construction of a robot arm for cable harness placing"            (in cooperation with the Department of Automation)</p>	<p><b>Department Partner Project</b></p>
<p>BMW Motors, Steyr, Upper Austria            "Development of simulation models for motor components"</p>	<p><b>Partner Project</b></p>
<p>Jenbacher Energy systems, Jenbach, Tyrol            "Construction of motor aggregates"</p>	<p><b>Partner Project</b></p>
<p><b>MINING ENGINEERING</b>            1. CALCINOR, E            2. DMD, B            3. NITRO BICKFORD, F            EU-Project "Blast Control" (in cooperation with Ecole des Mines de Paris)</p>	<p><b>Department Partner Project</b></p>
<p>1. MONTANWERKE BRIXLEGG AG, Tyrol            2. ZENTRALANSTALT FÜR METEOROLOGIE UND GEODYNAMIK Vienna            3. MONTANBEHÖRDE Vienna            "Seismic examination at the dolomite mine Schwarz"</p>	<p><b>Partner Project</b></p>
<p><b>FERROUS METALLURGY</b>            VOEST-ALPINE STAHL Linz GmbH            "Microstructure prediction of solidified slabs"</p>	<p><b>Department Partner Project</b></p>
<p>VOEST-ALPINE Stahl Linz GmbH            "Examination of the influence of alloy elements on the shrinkage behavior of solidifying steels"</p>	<p><b>Partner Project</b></p>
<p><b>ELECTRICAL ENGINEERING</b>            DB-Energy, Frankfurt, Germany            "Revision of power system control and disturbance detection of a static tie-frequency-converter 50Hz/16 2/3 Hz"</p>	<p><b>Department Partner Project</b></p>
<p>att (Car Design and Technology Team GmbH Wachauer), Hiefrau, Styria            "Electric drive for small vehicle, capacity 1kW, with sensorless asynchronous machine"</p>	<p><b>Partner Project</b></p>

<b>Department</b>	<b>CERAMICS ENGINEERING</b>
<b>Partner</b>	1. RHI AG, Vienna 2. VA STEEL Donawitz GmbH, Donawitz, Styria 3. VA STEEL Linz GmbH, Linz, Upper Austria
<b>Project</b>	"Characterization, simulation and optimization of the behavior of refractory building material under mechanical and thermomechanical stress"
<b>Partner</b>	HERAKLITH GmbH, Fürnitz, Carinthia
<b>Project</b>	"Clarification and avoidance of damages on exterior and interior plaster"

<b>Department</b>	<b>CONVEYING TECHNOLOGY</b>
<b>Partner</b>	BINDER&CO AG, Gleisdorf, Styria
<b>Project</b>	"Pipe conveyor new"

<b>Department</b>	<b>WASTE MANAGEMENT AND LANDFILL TECHNOLOGY</b>
<b>Partner</b>	1. AE ENERGY TECHNOLOGY GmbH, Vienna 2. FUNDER INDUSTRY GmbH, St.Veit/Glan, Carinthia
<b>Project</b>	"Utilization of biogenic waste/residual in fluidized bed incineration processes"
<b>Partner</b>	1. BAUFELD AUSTRIA; GmbH, Vienna 2. PEGGAUER CEMENT PRODUCTION GmbH, Wietersdorf, Carinthia
<b>Project</b>	"Thermal utilization of high caloric fraction from the mechanical biological residual waste treatment for the production of clinker"
<b>Partner</b>	FEDERAL MINISTRY OF BUSINESS AND ECONOMY, Vienna
<b>Project</b>	"Joint initiative KMU, sector energy and environment, eco-check-up"
<b>Partner</b>	1. FEDERAL MINISTRY OF AGRICULTURE, FORESTRY, ENVIRONMENT AND WATER MANAGEMENT, Vienna 2. AUSTRIAN KOMMUNALKREDIT AG, Vienna
<b>Project</b>	"Scientific supervision of remediation activities at the contaminated site Feldbach"

<b>Department</b>	<b>RESERVOIR ENGINEERING</b>
<b>Partner</b>	1. (RC) <sup>2</sup> Reservoir Characterization, Research and Consulting, Inc., Denver, Colorado, USA 2. HOT Engineering GmbH, Leoben, Styria
<b>Project</b>	"Mathematical modeling of hydrocarbon reservoirs"

<b>Department</b>	<b>GEOPHYSICS</b>
<b>Partner</b>	VERBUND-Electricity Production GmbH, Klagenfurt, Carinthia
<b>Project</b>	"Geophysical detection of dam leakage"
<b>Partner</b>	DRAU POWER PLANT AG, Klagenfurt, Carinthia
<b>Project</b>	"Control measurement system for embankment dams of river-run plants during remediation"
<b>Partner</b>	1. AUSTRIAN KOMMUNALKREDIT AG, Vienna 2. WASTE MANAGEMENT AND LANDFILL TECHNOLOGY Department, MUL
<b>Project</b>	"Control of decomposition capacity of biological in situ remediation processes"
<b>Partner</b>	APPLIED GEO-SYSTEM TECHNOLOGY, GmbH, Graz, Styria
<b>Project</b>	"Geo-electrical metrology on open stretches of water"

<p><b>PHYSICAL METALLURGY AND MATERIALS TESTING</b> BOEHLER EDELSTAHL GMBH, Kapfenberg, Styria "Development of basic principles for the improvement of high-speed steel"</p>	<p><b>Department</b> <b>Partner</b> <b>Project</b></p>
<p>PLANSEE AG, Reutte, Tyrol "Development of plasma-deposited layers of high-temperature materials"</p>	<p><b>Partner</b> <b>Project</b></p>
<p><b>NONFERROUS METALLURGY</b> PLANSEE TIZIT AG, Reutte, Tyrol "Metallurgy of refractory metals"</p>	<p><b>Department</b> <b>Partner</b> <b>Project</b></p>
<p><b>PHYSICAL CHEMISTRY</b> GTT-TECHNOLOGIES, Aachen, Germany 1. "Development of a thermodynamic optimization program for ChemSage" 2. "Evaluation of thermodynamic measurements" 3. "Computation of phase equilibrium concerning process and material optimization" 4. "Modeling of multistage technical processes"</p>	<p><b>Department</b> <b>Partner</b> <b>Projects</b></p>
<p><b>STRUCTURAL AND FUNCTIONAL CERAMICS</b> EPCOS OHG; Deutschlandsberg, Styria "Mechanical stability of thermistors"</p>	<p><b>Department</b> <b>Partner</b> <b>Project</b></p>
<p><b>PROCESS TECHNOLOGY AND ENVIRONMENTAL PROTECTION</b> BABCOCK BORSIG POWER, Graz, Styria "Optimization of spray scrubbers"</p>	<p><b>Department</b> <b>Partner</b> <b>Project</b></p>
<p>BRAUUNION Austria, Graz, Styria "Thermal utilization of spent hops"</p>	<p><b>Partner</b> <b>Project</b></p>
<p>METURA Powder Metal GmbH, Ranshofen, Upper Austria "Atomization of fused metal"</p>	<p><b>Partner</b> <b>Project</b></p>
<p><b>MATERIALS SCIENCE AND TESTING OF PLASTICS</b> 1. JOANNEUM RESEARCH GmbH, Graz, Styria 2. HOBAS ENGINEERING GmbH, Carynthia "Examination of a new method of calculation for centrifugally cast glass fiber reinforced polyester resin pipes"</p>	<p><b>Department</b> <b>Partner</b> <b>Project</b></p>
<p>HIGHTECH PRODUCTIONS GmbH, Mittersill, Tyrol "Development and property characterization of light-weight sandwich panels"</p>	<p><b>Partner</b> <b>Project</b></p>
<p><b>PLASTIC DEFORMATION AND PLANT MACHINERY</b> VOEST ALPINE INDUSTRIEANLAGENBAU GmbH &amp; Co, Linz, Upper Austria "Cross section control of rolled products in continuous mills for long product-minimal draught control"</p>	<p><b>Department</b> <b>Partner</b> <b>Project</b></p>
<p>VOEST ALPINE STAHL LINZ GmbH, Upper Austria "Front end bending and warping in 4,2m four-high stands of VOEST ALPINE Stahl Linz GmbH"</p>	<p><b>Partner</b> <b>Project</b></p>

# Discussing Knowledge -

Science thrives on the exchange of experience and ideas. In the year 2000 the departments and the Industrial Liaison Department organized 23 science events in total, 14 events took place in Leoben itself.

## ACADEMIC EVENTS

Worth mentioning is the "Sediment 2000" - an international conference which brought almost 400 scientists from more than 35 countries to Leoben for ten days. The Division of Prospection and Applied Sedimentology of the Department of Geosciences deserves the gratitude for the organization of this important event. So far this was the biggest "sediment conference", which was supported by international sponsors.

ASMET Austria celebrated the 74th anniversary at the annual ASMET Meeting 2000 with unusual events. This conference focused on the trends and future development of steel industry.

More than 460 experts discussed current issues of waste management at the DepoTech 2000. Preventive environmental protection, thermal utilization of waste as well as issues of disposal techniques and eco-process-balancing were the main topics of the conference.

### Erich-Schmid-Colloquium

(foreign lecturers also)

**Organization** Department of Metal Physics

**Location** University of Leoben

**Date** All year round, 2-weeks-intervals

### Selected Chapters of General, Analytical and Physical Chemistry

(seminar, foreign lecturers also)

**Organization** Department of Physical Chemistry

**Location** University of Leoben

**Date** all year round

### 11<sup>th</sup> International Winterschool

**Organization** Department of Physics

**Location** Mauterndorf, Salzburg

**Date** February 21 to 25, 2000

### 19<sup>th</sup> Plastic Deformation Conference

**Organization** Department of Plastic Deformation and Plant Machinery

**Location** Planneralm, Steiermark

**Date** February 27 to March 4, 2000

### ESIS Conference: Structural Stability of Ceramics

**Organization** Department of Structural and Functional Ceramics

**Location** Jülich, Germany

**Date** April 6/7, 2000

### 46<sup>th</sup> Physical Metallurgy Colloquium

**Organization** Department of Physical Metallurgy and Materials Testing

**Location** Lech, Vorarlberg

**Date** April 10 to 12, 2000

### Foundry Meeting

**Organization** Department of Foundry Technology and Austrian Foundry Research Institute

**Location** University Leoben

**Date** April 13/14, 2000

### Discrete Mathematics

Leoben-Laibach-Seminar

**Organization** Department of Mathematics, Division of Applied Mathematics

**Location** University of Leoben

**Date** April 27 to 29, 2000

### Alpine Gravimetry Colloquium

**Organization** Department of Geophysics

**Location** University of Leoben

**Date** May 5/6, 2000

### Austrian Mining Meeting

**Organization** Department of Mining Engineering

**Location** University of Leoben

**Date** May 16/17, 2000

# Exchanging Experience

## Annual ASMET Meeting "75 Years ASMET Austria"

**Organization** Department of Ferrous Metallurgy

**Location** University of Leoben

**Date** May 29 to 31, 2000

## Patent Law Is No Secret

**Organization** Industrial Liaison Department

**Location** Technology Transfer Center Leoben (TTZ)

**Date** June 8, 2000

## Innovation Management

**Organization** Industrial Liaison Department

**Location** Technology Transfer Center Leoben (TTZ)

**Date** June 14 to 16, 2000

## Sediment 2000

**Organization** Department of Geosciences, Division of  
Prospection and Applied Sedimentology

**Location** University of Leoben

**Date** June 19 to 28, 2000

## Materials Week

**Organization** Department of Structural and Functional  
Ceramics (Organization of the symposium  
"Micromaterials")

**Location** Munich, Germany

**Date** September, 25 to 28, 2000

## Best Practice and Trend in Maintenance

**Organization** Industrial Liaison Department, Austrian  
Technical Scientific Union for Maintenance  
and System Control

**Location** Semmering

**Date** October 10/11, 2000

## Fractography 2000

**Organization** Department of Structural and Functional  
Ceramics (co-organizer)

**Location** Stara Lesna, Slowakei

**Date** October, 15 to 17, 2000

## Ceramics Engineering Colloquium

**Organization** Department of Ceramics Engineering,  
Austrian Society of Ceramics Engineering

**Location** University of Leoben

**Date** October 20, 2000

## Occupational Safety and Risk Management in Mining

**Organization** Department of Mining Engineering

**Location** University of Leoben

**Date** October 23 to 25, 2000

## ESIS Conference

**Organization** Department of Structural and Functional  
Ceramics

**Location** Petten, NL

**Date** October 26/27, 2000

## 16<sup>th</sup> Plastics Colloquium Leoben Innovation and Development Tendencies in the Field of Fiber/Plastic Composites

**Organization** Department of Designing Plastics and  
Composite Materials, Department of  
Materials Science and Testing of Plastics,  
International Liaison Department, Union of  
Plastics Engineers Leoben (VLK)

**Location** University of Leoben

**Date** November 16/17, 2000

## DepoTech 2000

**Organization** Department of Waste Disposal and Landfill  
Technology, Department of Mining  
Engineering, Technology Transfer Center

**Location** Leoben

**Date** University of Leoben  
November 21 to 23, 2000

## French-Austrian Research Seminar

**Organization** Department of Mining Engineering

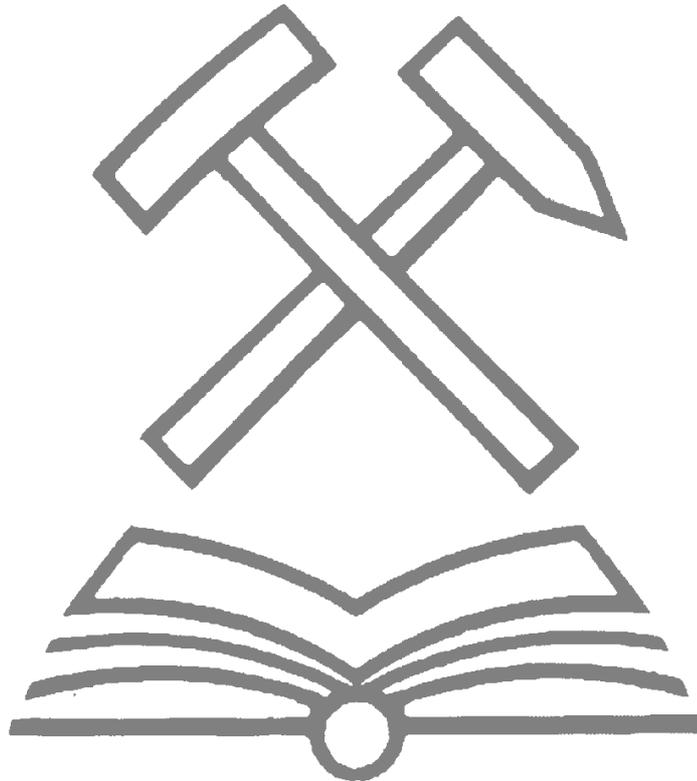
**Location** École des Mines, Fontainebleau, F

**Date** December 6 to 8, 2000

# Going Public

The academic performance, which can be demonstrated by the number of publications, is worth mentioning. If all submitted publications of the year 2000 are added, then there are a total of 924 publications.

## PUBLICATIONS



Trying to list all publications by scientists at the MU Leoben would go far beyond the scope of this annual report.

Therefore the chart printed below confines itself to mentioning only the number of publications in the different categories.

### PUBLICATIONS AT THE UNIVERSITY OF LEOBEN IN THE YEAR 2000

Presentations	257
Publications	149
Textbooks and reference books	13
Academic lectures and posters	505
<b>TOTAL:</b>	<b>924</b>

# Grade A

An extraordinary closeness of the graduates' relationship to their Alma Mater was demonstrated by the alumni survey. Nearly 100% would choose their degree program again.

Graduates of MU Leoben are successful, often in management positions, earn a noticeable income - and regard "their" university as the foundation stone of their carrier. This is the résumé of the alumni survey carried out by MU Leoben. More than 550 graduates turned in the questionnaire. Since 1500 questionnaires were mailed this means a high feed back of more than a third.

## Mainly management

Graduates from Leoben are extremely suitable for executive duties. Almost 30 % work on the management floor although a large amount of the questioned alumni (average age: 33 years) are only at the beginning of their carrier. The field of activity of 85% can be found in private enterprise, mainly large concerns. A fifth of the graduates can be found in high-tech industry.

For almost 50% their professional life is in accordance with their training. The comprehensiveness of the studies at MU is proved by the fact that many graduates work in fields totally different from their education.

8% of the graduates are self-employed. In the future an increase of the percentage can be expected as 72% of the already self-employed people are not older than 40 years and the spectrum of the possibilities to qualify as entrepreneur is also increasing.

## Top salaries

The annual income of the alumni is remarkable. More than a quarter earn more

than ATS 800,000 before tax annually (almost 60,000), 16% earn even more than ATS 1,000,000. Since the registered average age of 33 years is very low, this indicates that MU graduates get very high starting salaries.

Nearly all of the interviewed persons are convinced that their decision to pursue a degree program at Leoben was the right one. 97% would choose their field of study again. 77% are still convinced that Leoben was the right location for their studies. The imparting of specialized knowledge in particular subjects was graded high, even higher than the imparting of basic knowledge in engineering and natural sciences. The alumni expressed the need for faster integration of new knowledge into teaching and for a higher status of learning by doing, this has already been taken into account. Whereas the skills for systematical working received a high grade, the qualifications for procuring information and for project management were criticized.

The contribution of the study to the development of self-esteem, openness to lifelong learning as well as to the promotion of general knowledge was also ranked very high.

## ALUMNI



Successful alumni:  
left column: Barbara Punzengruber, Rudolf Streicher, Barbara-Annette Zahnt, Georg Pölzl, Hellmut Longin,  
right column: Sonja Schrempf, Helmut Langanger, Wolfgang A. Herritsch, Wolfgang Jelinek, Michaela Kraus

PERMANENT POSITIONS			
	YEAR 1998	YEAR 1999	YEAR 2000
University Professors	40	40	40
Academic staff (professors excluded)	143	146	147,5
Non-academic staff	209,5	210,5	211,5
Number of permanent positions in the given calendar year			

## RESOURCES

Not all permanent positions were occupied continuously in 2000. When employment is ended by retirement, termination of contract or - rather seldom - by dismissal or even death of the employee, a vacancy over a long period is the rule. As for re-appointments in the groups "academic junior faculty" and non-academic staff there are budgetary reasons for a longer vacancy. Is there a longer vacancy due to the sudden leave of a professor then mainly the problems at the search for eligible candidates impede a fast re-appointment.

# Faculty and Staff

In addition to permanent positions the university management knows of the following private employees, employed by the departments within the framework of their restricted legal capacity for contractual research projects.

Academic staff: 148 persons, a total of 71.75 man-years  
 Non-academic staff (incl. student assistants): 52 persons, a total of 19.03 man-years

All data on premises and facilities of MU Leoben in the period from 1998 to 2000 are summed up in the opposite chart. In 2000 23 lecture halls and seminar rooms were available which were used to 88% of capacity by courses in the winter semester 2000/2001 from Monday to Friday between 8 am and 6 pm. Next to teaching another 90 events took place in the lecture halls in the year 2000, thereof 80 which were organized by university members.

Floor space was increased slightly when the Industrial Liaison Department of MU Leoben took over part of the facilities of the Technology Transfer Center.

UTILIZABLE SPACE		
YEAR 1998	YEAR 1999	YEAR 2000
46.477	47.711	47.977
Utilizable space at the MU Leoben in m <sup>2</sup> incl. hallways and sanitary facilities		

## RESOURCES

# Energy and Floor Space

## Energy Statistics

That year the University of Leoben consumed energy worth about ATS 6,734,000 ( 489,363).

	ATS	EURO
6,9 tons diesel	53.300	3.873
3,3 tons fuel oil ultra-light	19.600	1.424
455.580 m <sup>3</sup> gas	2.412.400	175.316
2.656.407 kWh electricity	4.248.491	308.750
<b>Total</b>	<b>6.733.791</b>	<b>489.363</b>

# Financial

## RESOURCES

BUDGET DISTRIBUTION						
	YEAR 1998		YEAR 1999		YEAR 2000	
	ATS	EURO	ATS	EURO	ATS	EURO
<b>UT 0 (personnel expenses)</b>						
Personnel incl. DGB	202.463	14.713	217.890	15.835	227.268	16.516
Visiting professors incl. DGB	646	50	694	50	224	16
Allowances for faculty members	900	65	896	65	900	65
<b>Total expenses UT 0</b>	<b>204.009</b>	<b>14.226</b>	<b>219.480</b>	<b>15.950</b>	<b>228.392</b>	<b>16.598</b>
<b>UT 3 (Investments)</b>						
Appointments - Investments	20.082	1.459	13.107	953	4.182	304
Investments Departments	4.559	331	17.079	1.241	6.502	473
Equipment	948	69	1.284	93	327	24
Investments Service Sector	6.304	458	7.217	524	2.873	209
Other expenses	4910	357	1233	90		
<b>Total expenses UT 3</b>	<b>36.803</b>	<b>2.675</b>	<b>39.919</b>	<b>2.901</b>	<b>13.884</b>	<b>1.009</b>
<b>UT 7 (External Teaching)</b>						
Adjunct faculty and visiting professors	6.801	494	6.735	489	7.410	539
Visiting lecturers	322	23	398	29	383	28
Student assistants and tutors	1.862	135	2.100	153	1.872	136
DGB, miscellaneous	1.962	143	2.763	201	2.247	163
<b>Total expenses UT 7</b>	<b>10.946</b>	<b>795</b>	<b>11.996</b>	<b>872</b>	<b>11.912</b>	<b>866</b>
<b>UT 8 (Operating expenses)</b>						
Operating expenses of departments	23.462	1.705	23.800	1.730	22.290	1.620
Operating expenses incl. services and others	47.691	3.465	48.260	3.507	46.365	3.369
Foreign relationship	1.100	80	1.600	116	789	57
Z-Posts (imbursements, contributions)	2.000	145	2.000	145	2.300	167
<b>Total expenses UT 8</b>	<b>74.253</b>	<b>5.396</b>	<b>75.660</b>	<b>5.498</b>	<b>71.744</b>	<b>5.214</b>
<b>TOTAL</b>	<b>326.012</b>	<b>23.962</b>	<b>347.055</b>	<b>25.221</b>	<b>325.932</b>	<b>23.686</b>
<b>Allocation of Budget in ATS 1000 and EURO 1000 (rounded)</b>						
DGB ... social security and retirement contributions						

INCOME FROM CONTRACTUAL WORK						
	1998		1999		2000	
	ATS	EURO	ATS	EURO	ATS	EURO
Income from contractual work (for investments & personnel)	76.725	5.576	67.720	4.921	95.890	6.969
<b>Income of the departments for finished projects in the given calendar year in ATS 1000 and EURO 1000</b>						

# Report

The year 2000 is marked by a drastic fall of state funding.

The year 2000 was marked by an extremely late budget allocation on behalf of the BMBWK (Federal Ministry of Education, Science and Culture, end of May 2000) and a fall of state funding to a third of the previous year.

## Personnel expenses

The increase of personnel expenses is partly due to new dedications of posts, salary raises as well as to the payment reform of the Contractual Employee Act and the option right for civil servants in the non-academic area.

## Investments

The amount of funding was reduced from almost ATS 40 million (Euro 2,9 million) in the calendar year 1999 to round about ATS 9,3 million ( 676000). Additional negotiations resulted in an increase of the amount to 13,8 million ( 1 million). Only allocations for urgently necessary investments in

the field of EDP could be made, a small amount was spent on equipment and the rest on appointment commitments and the purchase of a large piece of equipment already planned the year before.

## External Teaching

As demonstrated by the opposite table it was possible to keep the total budget for teaching by lecturers not employed at the university on the high level of the calendar year 1999, that is ATS 11,5 million ( 840000)

## Operating Expenses

Since the allocation for operating expenses was reduced by approximately ATS 4 million ( 291000), the allocation to the departments also had to be reduced in spite of the cutback of energy and telephone costs: from almost ATS 24 million ( 1,7 million) in the year 1999 to about ATS 22 million ( 1.6 million) in the year 2000.

## RESOURCES

## Budgetary Priorities

In addition to implementing reductions the following priorities concerning the allocation of the budget were set:

- keeping of appointment commitments
- project crisis management
- employment of a specialist for occupational medicine
- enforced public relations work

# Excellent!

## Honors and awards for scientists at the University of Leoben

### PARTICULARS

#### Awards from other universities

O. Univ.-Prof. Dipl.-Ing. Dr. mont. Herbert Hiebler, Head of the Department of Ferrous Metallurgy, was awarded the "Agricola" medal, the highest award of the Technical University Ostrava (Czech Republic), honoring his engagement in the cooperation of both universities as well as his merits in the development of Czech-Austrian relations in the field of metallurgy. This award is named after Georgius Agricola who was not only one of the most versatile scientists of the renaissance but also founding father of modern metallurgy with his main work "De re metallica" in 1553.

#### Awards from other institutions or corporations

O. Univ.-Prof. Dipl.-Ing. Dr. mont Horst Wagner, Head of the Department of Mining Engineering, received several awards. Province governor Waltraud Klasnic herself handed Prof. Wagner the Austrian Cross of Honor for Science and Arts. In the year 2000 he was also elected full member to the Mathematics and Natural Sciences Research Department of the Austrian Academy of Sciences. The "South African National Institute of Rock Engineering" (SANIRE) granted Prof. Wagner the "Lifetime Achievement Award". For fourteen years Prof. Wagner

has been the president of the organization preceding SANIRE and vice president of the international society of rock mechanics.

Em. Univ.-Prof. Dipl.-Ing. Dr. Dr.h.c. mult. Günter B. L. Fettweis, former Head of the Department of Mining Engineering was elected honorary member of the international committee of the World Mining Engineering Congress in Las Vegas, USA at the 81st meeting.

Univ.-Doz. Dr. Reinhard Pippan, Deputy Head of the Department of Metal Physics and Dr. Franz Riemelmoser, faculty member at the same department till June 1999, were honored for their article "Mechanical Reasons for Plasticity-Induced Crack Closure under Plain Stress Conditions" by the European Society of Structural Strength as the best publication in the field of fracture research

In the framework of the Siegfried-Marcus Foundation Dipl.-Ing. Peter Ebner, university assistant at the Department of Electrical Engineering, won the prize of the Austrian Engineer and Architect Association, which amounts to ATS 40,000 ( 2900), for innovative drive solutions developed by him.



Several awards:  
Univ.-Prof. Dipl.-Ing. Dr.  
Horst Wagner

## Honors, awards and appointments by MU Leoben



On October 1, 2000 Univ.-Prof. Dr. Werner Sitte assumed office at the University of Leoben as new Head of the Department of Physical Chemistry. He was born in Salzburg and was associate professor of the Department of Physical and Theoretical Chemistry at the Technical University Graz before his appointment. MU Leoben welcomes a profound scientist in the field of physical chemistry amongst the ranks of its professors.

On August 1, Univ.-Prof. Dipl.-Ing. Dr. mont Gerhard Ruthammer assumed office. Prof. Ruthammer is responsible for petroleum and natural gas production engineering at the Department of Reservoir Engineering. He was engaged as manager at OMV for many years. At the same time Prof. Ruthammer also held courses at MU Leoben.

Dr. Christian Mitterer, faculty member at the Department of Physical Metallurgy and Materials Testing, was bestowed *venia docendi* as associate professor for the subject "Surface Technology".

Dr. Hans-Jürgen Gawlick, faculty member at the Department of Geosciences, Division of Prospection and Sedimentology, was bestowed *venia docendi* as associate professor for the subject area geology.

## PARTICULARS

### IN MEMORIAM

The University of Leoben mourns the loss of three university members who were snatched from this life unexpectedly.

In February 2000 senior official Werner Roßmann died. Since 1968 he had been employed at the Department of Ceramics Engineering as a lab technician.

In September 2000 Dr. Bernhard Kalteis died. He was university assistant at the Department of Mineral Processing where he had worked since 1983 and received his doctoral degree in 1989. Dr. Bernhard Kalteis was also a member of the faculty senate.

Im December 2000 Eva Szabo died. Since 1974 she had been employed at the Department of General and Analytical Chemistry as a chemical technician.

The deceased will always be remembered at the University of Leoben.

## Honors and prizes for graduates and students at MU Leoben

### PARTICULARS

#### Rector-Platzer-Ring

On the occasion of the 125<sup>th</sup> anniversary celebrations of the MU Leoben, the former "Mining Academy", an honorary ring - the Rector-Platzer-Ring- was donated for graduates who completed their studies with honors. Representatives of this foundation are "ASMET" (Austrian Society for Metallurgy) and the Austrian Mining Association as founding members as well as the "Austrian Society of Petroleum Engineering" and the "Union of Plastic Engineers in Leoben". In 2000 the Rector-Platzer-Ring is awarded to the following ladies and gentlemen at their graduation:

- Dipl.-Ing. Nina Schöner,  
Applied Geosciences;
- Dipl.-Ing. Steffen Riemer,  
Applied Geosciences;
- Dipl.-Ing. Thomas Mangelberger,  
Mining Engineering;
- Dipl.-Ing. Günter Woltron,  
Ceramics Engineering;
- Dipl.-Ing. Michael Stoschka,  
Mechanical Engineering;
- Dipl.-Ing. Ewalt Georg Badisch,  
Materials Sciences;
- Dipl.-Ing. Gregor Alfred Arnoldner,  
Materials Science;
- Dipl.-Ing. Gerhard Strobl,  
Materials Science.
- Dipl.-Ing. Wolfgang Hochfellner,  
Petroleum Engineering;
- Dipl.-Ing. Manfred Leitern,  
Petroleum Engineering;
- Dipl.-Ing. Saleh Farag Saad,  
Petroleum Engineering

**Em. Prof. Dipl.-Ing. Dr.techn.  
Rudolf POSSELT's Travelling Fund**  
The foundation annually donates a prize of

ATS 30,000 and supports young scientists working at MU Leoben for an intended study trip abroad. The prize winner of the year 2000 is:

Dipl.-Ing. Sabine Köllerer  
Department of Mineral Processing

#### Hans-Theisbacher-Preis

This prize of ATS 60,000 (total) is donated by the foundation of Mrs. Friedl Theisbacher and is awarded for excellent theses in the field of refractory materials. This year's winner is the graduate of the field of studies Ceramic Engineering:

Dipl.-Ing. Hans Peter Schweiger

#### Prof.-Fuglewicz-Memorial-Prize

In memoriam of Prof. Josef Fuglewicz, who was Head of the Department of Mining Engineering from 1928 to 1948 this prize is awarded for outstanding diploma and doctoral theses in the field of mining engineering. Winner of the year 2000 is:

Dipl.-Ing. Thomas Mangelberger

#### Wolfgang-Wick-Honorary Prize

In memoriam of Dkfm. DDr. Wolfgang Wick, honorary university senator of MU Leoben, this prize is awarded for outstanding research in the field of Ceramic Engineering. In 2000 the prize went to:

Dipl.-Ing. Günter Woltron

#### Environmental Research Prize of VA Steel, Inc.

This prize of ATS 120,000 in total ( 8720), donated by VOEST Alpine Steel, Inc. is an award for diploma and doctoral theses which contribute to the advancement of environmental protection. In 2000

the winners are:

Dipl.-Ing. Monika Michalski,  
Industrial Environmental Protection  
(waste disposal and landfill technology);  
Dipl.-Ing. Silvia Grossart,  
Industrial Environmental Protection  
(process engineering);  
Dipl.-Ing. Gerold Thek,  
Industrial Environmental Protection  
(waste disposal and landfill technology);

### Veitsch-Radex Grant

This grant of ATS 100,000 in total ( 7267) was donated by VEITSCH-RADEX. It is a special honor for the achievements of students of the field of Mining Engineering, Ferrous Metallurgy, Ceramic Engineering and Materials Science. This year's winners are:

Dipl.-Ing. Günter Woltron,  
Ceramics Engineering;  
Jörg Korp,  
Metallurgy;  
Dipl.-Ing. Ewald Badisch,  
Materials Science.

### RAG-Sponsorship

The RAG, Inc. donated this Prize of ATS

100,000 in total ( 7267) for the financial support of Petroleum Engineering students with excellent credits for the required semester abroad. In 2000 the winners are:  
Werner Schinagl,  
Daniel Dominique Mayer,  
Christoph Zinner.

### Honorary Prize of the Austrian Ministry of Education, Science and Culture (BMBWK)

Dipl.-Ing. Christian Redl was awarded the honorary prize of the Austrian Minister of Education, Science and Culture as best graduate of MU Leoben in the academic year 1999/2000. Redl studied Petroleum Engineering.

### Performance Bonus

Alexander Etschmaier, who wrote his diploma thesis as a student of Materials Science in cooperation with the company Siemens Automation and Drives in Regensburg, received the bonus of 2000 (ATS 27,520) in recognition of his outstanding and successful engagement in the field of the development of Cd-free soldering materials.

Honoring by Federal Minister Gehrler: DI Christian Redl, best graduate of the academic year 1999/2000, received the honorary prize of the Ministry of Education.

Foto: Fotostudio Haslinger



# Festivities and Events

## EVENTS

Next to three academic ceremonies, the "Ledersprung", the welcome party for first-year students and the university ball the following festivities, which are organized by the Education and Sports Department, also belong to the annual events at MU:

- the concerts of the university orchestra (two in the year 2000);
- the artistic contest and exhibition;
- the photo contest and exhibition.

The following events also took place in 2000:

### January 13

"Breaking the Surface" was the title of a fascinating lecture by Dr. de Haemer, former captain of a nuclear missile submarine of the US Navy.

### February 17

FIT (women for engineering jobs): About 100 Styrian female graduates attended the recruitment program which focuses on demonstrating to women the potentials of an engineering education at MU Leoben.

### May 24

Univ.-Prof. Dr. Albert Kneissl was elected first vice rector.

### May 26/27

"An amusing journey through science" could be the motto of the Science Week which took place in Austria for the first time. 15 departments of MU Leoben participated. The events at Leoben attracted an extremely positive response from media and visitors.

### June 14

The first "Materials Day" of MCL (Materials Center Leoben) offered the opportunity to inform oneself about the research partners of MCL and their achievements.

### September 28 to 30

The "Montanhistorischer Verein" (a society concentrating on mining history) organized a series of lectures on the topic "Austrian Mining Engineering in the 20th Century". Numerous issues of the field of mining, metallurgy as well as law and heritage were dealt with.

### November 8

"i2b - ideas to business", the biggest Austrian business concept competition was presented also at MU Leoben. Numerous interested persons asked for information on this competition.

### November 24

The French attaché for science Dr. Jean-Michel Nataf visited Leoben to discuss a future double degree agreement between MU Leoben and Hautes Etudes Commerciales Paris (HEC), an internationally renowned university of economics and business administration.



Science Week:  
Departments of MU  
Leoben organize a thrilling  
and comprehensible pre-  
sentation of science

(Photo: Außeninstitut)



ScienceWeek:  
Rector Pöhl on  
a solar bike

(Photo: Außeninstitut)

## EVENTS FOR STUDENTS AT MU LOEBEN extracurricular activities

### May 12

The end spurt of the autonomous mobile robots seminar, initiated by the Department of Automation, took place in the entrance hall of the cafeteria. Quite a few robots proved to be smart high-performance racing cars



Autonomous Mobile Robots Seminar:  
Robots as high-performance racing  
cars (photo: Department of Automation)

### June 6

"Kontaktforum" was the name of a company fair at MU Leoben. It was organized by the student organization IAESTE. Numerous reputable companies presented themselves to students and prospective employees. This way the successful contact forum contributed to an intense interaction between economy and students.



First company fair at MU Leoben

### December 13

Foreign students at MU Leoben founded the "International Students Union Leoben" (ISUL), a transcontinental union of participating students from Africa, Asia and Europe. As a forum and service center for all foreigners studying at Leoben they want to help to overcome cultural barriers and integration problems and organize special events.



Assisted by Prof. Weiß  
(referee for foreign  
students) international  
students found the  
"International Students  
Union Leoben"

Photo Freisinger

## EVENTS



# History

The history of MU Leoben is marked by a continuous development of the academic range of studies.

## APPENDIX

Due to an initiative of Archduke Johann the "Styrian Corporate School of Mining" was established in Vordernberg on November 4, 1840. The inaugural address of Peter Tunner demonstrates the intention of keeping the instruction on an academic level and of developing his school to a center for all experts in mining and metallurgy from the alpine region.

The revolutionary year 1948 put an end to extremely successful years in Vordernberg and led to a significant change. Peter Tunner initiated the nationalization of his school and the transfer to the near town of Leoben. On November 1, 1849 the "Imperial and Royal School of Mining" could be inaugurated in Leoben with 48 students initially enrolled.

On December 15, 1874 the "Imperial and Royal School of Mining" received a new statute which guaranteed a sound and steady development. The status of the teachers was ranked equal to the status of professors at Technical Universities.

An imperial decree of July 31, 1904 changed the name of the mining academy to "University of Mining". Equal status to technical universities was finally gained when the academy was entitled to bestow doctoral degrees. In fall 1910 the university could move into new quarters which were extremely spacious for those days. Due to the rapid development of mining engineering the fields of studies Mining Engineering and Metallurgy were separated in the interval between World War I and II and a new study program was developed. In 1934 the administration of the

University of Mining and of the Technical University of Graz was united and the two preparatory years of studies were transferred to Graz. This meant a serious decrease of enrolment which was followed by a severe lack of a young generation of academics for the Austrian mining industry. The reinstatement of the independent University of Mining by the federal law of April 3, 1937 is due to the joint efforts of industry, professors and all residents of Leoben.

An era of steady development was interrupted again by the annexation of Austria to the Third Reich in 1938. World War II brought serious interferences in studying. These problems could be mastered by a decisive rector after 1945 and an urgently necessary extension for laboratories was built.

The rapid stabilization after the war can also be seen in the increasing enrolment. After 1955 new fields of studies were added continuously, which in addition to the core subjects encompass a broad range of subject areas from raw materials to materials.

In 1970/71 the fields of studies Plastic Engineering and Materials Science were added. In 1990 the planning of two new fields of studies, Applied Geosciences and Industrial Environmental Protection was begun, they were installed in 1992. The construction of a new building, opened in 1970, also demonstrates the extension. Since October 1, 1975 the university is called "Montanuniversität Leoben" according to the University Organization Act.

# Degree Programs

In Austria the ten degree programs at MU Leoben - ranging from raw materials to component/systems - can only be studied in Leoben.

Requirements	<b>Mining Engineering</b> Mining Processing and refining Geomechanics and tunneling
Requirements	<b>Mine Surveying</b> Geoinformatics and data management Mine damages and environmental techniques
Electives	<b>Petroleum Engineering</b> International Study Program Simulation Technologies Business management
Electives	<b>Metallurgy</b> Ferrous metallurgy Non-ferrous metallurgy Metal forming Casting and component design Industrial economy, energy and environment technology
	<b>Ceramics Engineering</b>
Modules	<b>Mechanical Engineering</b> Computational Design Automation and Performance Testing Plant and Heavy-Machinery
Electives	<b>Plastic Engineering</b> Polymeric materials development and characterization Production technology & component design
Requirements	Polymeric Materials and sustainable development Quality guarantee and management Operation & production management

## APPENDIX



Electives	<b>Materials Science</b> Metallic Materials Metal physics and general material physics Ceramic materials Materials of electronics
Requirements	Biomaterials Modelling and simulation Polymeric materials Project and quality management
Electives	<b>Applied Geosciences</b> Applied geophysics Petroleum geology Raw material geology Environmental geology and hydrogeology
Requirements	<b>Industrial Environmental Protection, Disposal Techniques &amp; Recycling</b> Process engineering Waste disposal and waste management
Electives	Recycling technology Industrial engineering/design Environmental management/safety Contaminated sites Automation Applied business management Plant construction Alternative energy Noise and radiation protection

# Departments

## E-mail-addresses and heads of departments

### APPENDIX

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