MINING ENGINEERING RESEARCH PROJECTS
DEPARTMENT OF MINING AND PETROLEUM ENGINEERING
Universidade de São Paulo  USP

- Established in 1934 (80th anniversary)
- State University (no tuition fee)
- Most prestigious Brazilian University
  - The Times Higher Education
  - Webometrics Ranking of World Universities
- Budget of about R$ 4 billions
- Over 200 undergraduate programs
- Campus: 8 campi

www.usp.br
Escola Politécnica (Engineering School)

- Established in 1893 (122\(^{nd}\) anniversary)
- 15 Departments
- 457 professors
- 4500 undergraduate students (17 programs)
- 2500 graduate students (11 programs)

www.poli.usp.br
Department of Mining and Petroleum Engineering

- 75 years of excellence in engineering education, research and consultancy
- International reputation
- Complete infrastructure for scientific and technological research
- Updated library with thousands of books and scientific journal access
- SPE Student Chapter – Gold Standard Award

www.pmi.poli.usp.br
Department of Mining and Petroleum Engineering

Mining Engineering Research Areas

- Process mineralogy and geometallurgy
- Materials characterization
- Occupational Safety and Health
- Transport Phenomena and Surface Chemistry
- Rock Mechanics
- Mine Planning
- Environmental Planning and Management
- Mineral Processing, Simulation & Process Control
- Mineral Exploration, Sampling and Reconciliation
- USP Centre for Responsible Mining

Master, Doctorate, Pos doctorate

Research at PMI
http://www.pmi.poli.usp.br – Pesquisa
http://www.pmi.poli.usp.br – Pós Graduação
MINE PLANNING

Research Line
Research on the methods of mine planning, including mine design and reserve estimation, margin ranking and pit optimization, scheduling and forecasting, operational optimization and equipment selection and grade-control strategy.

Laboratory of Mine Planning
http://www.usp.br/lapol

Prof. Giorgio de Tomi, PhD
gdetomi@usp.br
ENVIRONMENTAL PLANNING AND MANAGEMENT

- Environmental and social impact assessment
- Land rehabilitation and mine closure planning
- Ecosystem services and biodiversity offsets
- Sustainability in extractive industries
- Management tools and systems

Prof. Luis E. Sánchez, PhD
lsanchez@usp.br
OCCUPATIONAL SAFETY AND HEALTH

- Safety risk management
- Physical agents: noise, heat, radiation
- Chemical agents: gas and particulate
- Rock mass vibration due to explosives
- Cultural Evolution Journey for Safety and Industrial Hygiene – G MIRM, with Univ. Queensland, AU
- Laboratory facilities
MINING, ENVIRONMENTAL CONTROL, HEALTH AND SAFETY

• Mining and blast design
• Environmental control: noise, particulate matter, blast induced vibration (seismic monitoring and calibration)
• Industrial hygiene
• Safety engineering

Prof. Wilson S. Iramina, PhD
wilsiram@usp.br
Research Line
Research on the development and application of innovative technical and managerial processes to enable the conversion of artisanal miners into small-scale responsible operations. It is hosted at the Department of Mining and Petroleum Engineering and its body of researchers includes professors from USP Escola Politécnica, Instituto de Geociências e Instituto de Astronomia e Geofísica.

USP Centre for Responsible Mining
http://www.usp.br/nap.mineracao

Prof. Giorgio de Tomi, PhD
gdetomi@usp.br
RADON CONTROL IN UNDERGROUND MINES

• Assessment of radon and its progeny concentration mainly in non-uranium underground mines
• Control of radon and its decay products by implementation of an optimized ventilation
• Modeling and improvement of ventilation systems for different underground mining methods
• Prevention of radiation health hazards by monitoring and maintaining radon and its progeny concentrations below international standards

Prof. Anna Luiza M. Ayres da Silva, PhD
alayres@usp.br
MINERAL ECONOMICS AND PUBLIC POLICIES

Research Line
Study of the main drivers, restrictions and controls in the production and consumption of mineral commodities and oil in the State of São Paulo, based on data and information collected from the industrial sector as well as official sources from regional and national agencies. This research line supplies guidelines and information to support public policies and government actions for the mineral and oil sectors in São Paulo.

Prof. Manoel Rodrigues Neves, PhD
manoel.rneves@gmail.com
MINERAL EXPLORATION, SAMPLING & RECONCILIATION

Research Line
Research on the methods required to define and evaluate mineral deposits, including quantification and qualification of reserves, definition of the ore heterogeneity, sampling and sample preparation techniques, and reconciliation as a tool to continually evaluate the geological models and improve planning and production processes.

Laboratory of Mineral Prospecting and Exploration

Prof. Ana Carolina Chieregati, PhD
ana.chieregati@usp.br
ROCK MECHANICS

Research on the mechanical behavior of rock and rock masses including rock dynamics and time dependent behavior, slope stability and landslide hazard protection, tunnel support and reinforcement mechanics and numerical modeling of excavations in rock.

Prof. Eduardo César Sansone, PhD
esansone@usp.br
MINERAL PROCESSING, SIMULATION & PROCESS CONTROL

• Laboratory and pilot plant scale equipment's: comminution, sizing, classification, flotation, gravity, electric and magnetic separation, thickening, filtering, transport, waste treatment.

• Simulation and process control: JKSimMet software

Prof. Homero Delboni Junior, PhD
hdelboni@usp.br

Prof. Maurício G. Bergerman, PhD
mbergerman@usp.br
Main projects under development

- Mineral processing plants modelling and optimization. More than 250 projects developed since 1987
- Evaluation of the energy consumption and wear in grinding circuits in which the feed has gone through a pre-concentration stage. Project financed by CNPq and USP
- Proposal of a methodology for designing and selection of high energetic efficiency regrinding mills. Project financed by FAPESP and USP
PROCESS MINERALOGY AND GEOMETALLURGY

• Ore characterization and **geometallurgy**: quantitative mineralogy by automated image analysis: P, Zn, Pb, Ni, iron ore, bauxite, gold, rare earth
• Characterization of products from mineral and metallurgical processing
• 3D characterization by **µ-tomography** (reservoir rocks, ore, concrete, materials)
• Particle characterization: size, shape, porosity, composition, phase’s associations
• **Materials characterization** (ESEM, SEM, MLA, XRD, XRF, ICP, MIP, 3D-XRM, LAS)
• Multiuser facility – LCT Laboratory

www.lct.poli.usp.br

Prof. Henrique Kahn, PhD
henrique@lct.poli.usp.br
Prof. Carina Ulsen, PhD
carina@lct.poli.usp.br
TRANSPORT PHENOMENA AND SURFACE CHEMISTRY

Research Line
Research on the surface chemistry of froth flotation of minerals including surfactants, mechanisms of activation and depression, fine particle flotation, sulfide flotation and formation of stable froth.

Laboratory of Transport Phenomena and Surface Chemistry

Prof. Laurindo de Salles Leal Filho, PhD
lauleal@usp.br
ELECTROCHEMISTRY OF SULPHIDE MINERALS

The purpose is to elucidate the electrochemical behavior of sulphide minerals, from grinding to pulp medium, in order to enhance froth flotation recoveries.

Fe $\rightarrow$ Fe$^{2+} + 2e^-$

O$_2$ +2H$_2$O + 4e$^-$ $\rightarrow$ OH$^-$

Cathodic sulphide mineral

2X$^-$ $\rightarrow$ X$_2$ + 2e$^-$ (thio-collector) in the pulp medium

MeS $\rightarrow$ Me$^{2+}$ + S + 2e$^-$

Anodic sulphide mineral

Me$^{2+}$ + S + 2e$^-$ (thio-collector) in the pulp medium

Oxygen effect

Fe(OH)$_3$ precipitation

Grinding medium

Steel ball

Prof. Jean Ferrari, PhD
jeanferrari@usp.br

Prof. Patrícia Matai, PhD
pmatai@usp.br

Prof. Laurindo de Salles Leal Filho, PhD
lauleal@usp.br

Elemental sulphur

Prof. Laurindo de Salles Leal Filho, PhD
lauleal@usp.br

Prof. Jean Ferrari, PhD
jeanferrari@usp.br

Prof. Patrícia Matai, PhD
pmatai@usp.br
CONSTRUCTION AND DEMOLITION WASTE RECYCLING

- Characterization of construction and demolition waste
- Mineral processing applied to recycling
- Production of recycled sand with low porosity
- Characterization procedures and quality control of recycled aggregates
- International cooperation in research projects

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