

The research activity of the Department focuses on the study of chemistry and mineralogical composition of rocks of igneous, sedimentary and metamorphic origin from Poland as well as different parts of Earth.

The research objectives not only involve the phase identification, but also concentrate on the understanding of transformation mechanisms which take place during weathering, chemical and structural changes, and modifications of mineral properties.

The ultimate goal is to determine the possibilities of practical use of the obtained results in the field of: mineral resources, technology and environmental protection.

The scientific and research activity of the Department deals with the issues of mineralogy, crystal chemistry, geochemistry, petrology and geology of mineral deposits. The research also includes analysis of solid matter of extraterrestrial origin.

The **mineralogical research** conducted in the Department has both a scientific and applied character. The employees work on systematics and nomenclature of minerals. The basic research includes the refinement of silicate and aluminosilicate complex structures and identification of new phases. Apart from aluminosilicates the interest is also focused on other crystalline phases e.g. iron (oxyhydr)oxides, sulfates, sulfosalts as well as rare minerals e.g. phosphates, arsenates and vanadates. The characterization of solid matter goes beyond Earth and is extended to extraterrestrial minerals, in particular matter formed in the protoplanetary disc of the solar system. Research groups of the Department also carry out studies which could be classified as experimental mineralogy e.g. kinetics and mechanisms of minerals crystallization/dissolution and their interaction with living organisms, the role of bacteria in mineral-forming and soil-forming processes. The studies on the mineralization of human organism are undertaken (biomineralogy). The mineralogical topics also include gemology devoted to characterization of precious stones (gems) as well as organic, amorphous substances e.g. fossil resins. The applied mineralogy is devoted to crystallochemical research on organo-mineral materials in terms of their use in technologies and environmental protection. The experiments are carried out on synthesis and modification of clay minerals, zeolites and other phases in order to obtain new type of catalysts, adsorbents and nanocomposites.

The **petrological** research conducted in the Department leads to determination of mineral

composition, properties and usefulness of genetically and stratigraphically diverse rocks collected from different regions worldwide. The characterization also involves age determination. The examples of realized research include: characterization of geological sediments for the determination of their origin, characterization of mineralization from the economical point of view, studies on metamorphic rocks of the Sudety mountains, characterization of sedimentary rocks in terms of shale gas exploration. The petrological research is connected also with stone-based products and accompanying sediments discovered in archaeological sites. Apart from the determination of its genesis, the collected material enables paleoclimatic reconstructions.

The **geochemical** research carried out by the Department covers a broad spectrum of issues both in the field of general geochemistry and its applications in the field of geology, mineral engineering and environmental protection. This involves petrological analyses of igneous and metamorphic rocks using major and trace elements as well as dating of geological processes by applying various methods. The geochemistry is also devoted to model and experimental research on CO₂ reactivity and its interaction with rocks in terms of CO₂ sequestration. The conducted research provides information on the transformation mechanisms of minerals in aquatic systems (mineral-rock interaction) also in the presence of bacteria (geomicrobiological research). The studies of geochemical groups involve the analysis of natural precipitates, industrial waste and atmospheric dust. In terms of environmental assessment the chemical/mineralogical composition of soils and selected plants is determined to analyze the toxicity which could be related to industrial activity (e.g. coal mining and the power industry).

It is worth to underline the research which involves mineralogical, geochemical and petrological analysis of **metamorphic complexes of Spitsbergen**. Each year a polar expedition to this geological site is organized by the Department employees with cooperation with other Polish and foreign partners. The expeditions also involve PhD and MSc students of the Department.

In the past 10 years the employees of the Department have completed over 40 project of scientific and/or applied character which were financed by different Polish institutions: Ministry of Science and Higher Education, National Science Centre, National Centre for Research and Development and National Fund for Environmental Protection and Water Management.