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Laterites and paleoclimates. Weathering processes and anthropogenic impact

The European Union of Geosciences held its 9th biannual meeting in Strasbourg, March 23–27, 1997. During this meeting, Symposium No. 63, *Weathering Processes: Mineral deposits and soil formation in tropical environments,* was merged with Symposium No. 78, *Anthropogenic Impact on Weathering processes* (co-sponsored by IGCP Project 405). The resulting symposium No. 63, *Weathering processes and Anthropogenic Impact*, was held under the sponsorship of EUROLAT[1] and attracted 36 oral and poster presentations and about 100 participants, reflecting the interest of the Earth Sciences community in weathering processes and anthropogenic impact.

EUROLAT was founded in 1984 as an informal group of scientists working on laterites, tropical weathering and global environment. The main objectives are (1) maintaining a network of information and exchange between laboratories working on tropical regions and on global environment, (2) initiating scientific cooperation among European laboratories, (3) optimizing cooperation and exchange between research scientists of tropical countries and European laboratories. The activities of EUROLAT are mainly the organization of scientific meetings to exchange and discuss results of ongoing research activities and summer schools to improve the knowledge base on laterites, tropical weathering and global environment. Since 1984, EUROLAT meetings have been organized in Strasbourg (1984), Delft (1985), Granada (1986, jointly with the 1st Symposium on Geochemistry of the Earth's Surface), Freising-Weihenstsphan (1987), Louvain-la-Neuve (1988), Strasbourg (1988), Strasbourg (1989), Aixen Provence (1990, jointly with the 2nd Symposium on Geochemistry of the Earth's Surface), Berlin (1991), Orléans (1993), Belfast (1994, jointly with IGCP 317 meeting), Bondy (1995), Aveiro (1996) and Strasbourg (1997, during the 9th EUG meeting). After 4 years of reflection, the next meeting will be probably organized in Toulouse (2001).

The aim of Symposium No. 63 was to bring together results from various sources and disciplines related to weathering processes, particularly in tropical regions, and to the impact of anthropogenic activities on such processes. During the symposium, different approaches were presented going from theoretical models, thermodynamic and kinetic characterization of weathering, isotope tracing of weathering processes, laboratory experiments and field measurements. Weathering systems are an essential clue to the understanding of Earth surface processes. Global biogeochemical cycles are controlled by weathering reactions, which themselves bear a strong influence on global climate. In order to understand present global change, it is necessary to look also at the extreme paleoclimatic border limits of the Earth system. On the multimillion-year scale, weathering processes are a decisive factor controlling atmospheric CO_2. Moreover, mineral resources are often hidden by thick weathering mantles in many parts of

[1] European Network on Lateritic Weathering and Global Environment (Web Site: http://mindepos.bg.tu-berlin.de/eurolat).

the world. In order to discover concealed ore deposits, it is essential to understand the three-dimensional evolution of a landscape by integrating geomorphic, hydrologic, geological and biogeochemical processes and concepts.

In our changing world, anthropogenic activities also play an important role in weathering processes. Particularly, acid precipitation due to anthropogenic emission of sulfur and nitrogen in the atmosphere by combustion of fossil fuels has a large impact on the soil-vegetation system, on the rock weathering and on the surface water quality. Moreover, it is also a source of deterioration of lithic building materials, including those used in monuments and art works. Other anthropogenic perturbations also have an impact on weathering processes and during the symposium, some results were also presented on the impact of mining activities on environmental pollution and of nitrogen fertilizers on weathering processes.

This special issue of Chemical Geology groups together 12 papers of which 10 have been selected from among the Symposium No. 63 presentations, one has been selected from Symposium No. 77, *Anthropogenic Contaminants in Aquatic and Sedimentary Environments*, and another has been offered independently by the authors.

The four first papers are devoted to the study of weathering processes in different hydroclimatic conditions and during different geological periods. The first one addresses the dating of kaolinization processes in sedimentary kaolins since the Late Triassic from the western border of the Bohemian Massif (Northeast Bavaria, Germany), using hydrogen and oxygen isotopic measurements. The second focusses on the genesis of a calcrete profile developed on granite in the Toledo mountains (Central Spain), using chemical mass-balance of major and trace elements. The third paper presents results of a comprehensive $^{40}Ar/^{39}Ar$ study performed on supergene K–Mn oxides sampled from different sub-alpine mountain terrains in Germany and in France, in order to date weathering processes responsible for supergene Mn mobilization during the Neogene. The fourth paper deals with weathering processes in a gibbsite-bearing lateritic profile developed on basaltic parent rock from the Jos Plateau (NE Nigeria) using micromorphological analysis and chemical and mineralogical changes through the profile; it provides new data relevant to the Tertiary geomorphological evolution of the Jos Plateau.

In the fifth paper, a newly developed technique based on measurements of radioactive cosmogenic ^{10}Be and ^{26}Al produced in the lattice of quartz is applied by the authors to two lateritic sequences developed under rain forest conditions in Cameroon and in Gabon; this technique appears to be a powerful tool for the quantitative study of different weathering processes involved in the development of lateritic surfaces.

The next section contains four papers dealing with the study of weathering processes at the catchment scale, going from small catchments (Nyong in Cameroon and the Yaou in French Guiana) to large river basins (Indus in the Himalayas and the Loire in France). The first paper provides detailed information on the nature of fluvial suspended matter from a tropical lateritic watershed, the Nyong river basin , using different techniques (XRD[2], TEM[3], FTIR[4], EPR[5], DRS[6] and ICP-MS[7]). This study partially explains the origin of the fluvial particles (soils, groundwater, swampy zone) and determines the main biogeochemical processes responsible for their transport into the river. In the second paper, the authors use the water chemistry measured in various compartments of the Yaou catchment in western French Guiana and mass-balance calculations to quantify the weathering rate of the different minerals, the deepening rate of the weathering profile and the latosol development rate under rainforest conditions on ultramafic schists. The third paper presents the results of hydrochemical and isotopic ($\delta^{13}C$, $\delta^{18}O$, $\delta^{34}S$ and $^{87}Sr/^{86}Sr$) investigations in the Indus river basin and quantifies the contribution of carbonate and silicate rock weathering to the fluvial transport of solute elements. In the last paper of this section, the authors use the temporal fluctuations of major and trace

[2] X-ray diffraction.
[3] Transmission electron microscopy.
[4] Fourier transform infrared spectroscopy.
[5] Electron paramagnetic resonance spectroscopy.
[6] Visible diffuse reflectance spectroscopy.
[7] Inductively coupled plasma mass spectrometry.

elements and of strontium isotopic ratios ($^{87}Sr/^{86}Sr$) in the Loire river water to estimate the contributions of atmospheric inputs, carbonate and silicate rock weathering, and anthropogenic pollution to the total dissolved river load.

In the last section of this special issue, three papers are devoted to the impact of acid atmospheric inputs on soil acidification and weathering processes. In the first one, the authors combine field measurements of strontium isotopes ($^{87}Sr/^{86}Sr$) with a water–rock interaction kinetic model KINDIS[8] to assess the pool of cations released by mineral weathering to surface waters in a small forested catchment, the Strengbach (Vosges mountains, France), draining a base-poor leucogranite and receiving subsequent inputs of protons. The second paper looks at the impact of atmospheric acid deposition on the mobility of trace elements in 34 springs sampled on five different rock types in the upper Ecker watershed (Northern Harz mountains, Germany); the authors elaborate on the effects of pH, ANC[9] and bedrock chemistry on metal concentrations in spring waters and they try to isolate the role of other environmental factors such as precipitation and catchment elevation on the weathering processes. The final paper uses the steady state soil chemistry model PROFILE to calculate the chemical status of forest soils and the rock weathering rates under acid deposition in two contrasting regions of Switzerland (the Jura Mountains on carbonate rocks and the Ticino area on metamorphic crystalline rocks) in order to assess the critical loads[10] of acidity for the soils of these two regions.

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[8] KINDIS code : kinetic dissolution model.
[9] Acid Neutralizing Capacity.

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[10] Quantitative estimates of an exposure to one or more pollutants below which significant harmful effects on specified elements of the environment do not occur according to present knowledge.