A biogeochemical study at the Eunsan gold mine, Haenam district in Korea

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A biogeochemical survey of epithermal gold deposit was carried out at the Eunsan gold mine, Haenam district in Korea. The Au-Ag bearing quartz veins of the mine occur as narrow open-space fillings within the Cretaceous silicic pyroclastics. The vein minerals consist mainly of quartz, sericite, pyrite, chalcopyrite and galena with some electrum and argentite.

The objectives of this survey were to study the relationship between gold and associated elements contents in rock-soil-plant system and to evaluate the applicability of biogeochemical prospecting for gold occurrences.

Samples of rocks, soils and leaves of five plant species (*Pinus densiflora Siebold, Quercus aliena Blume, Mallotus japonicus, Robinia pseudoacacia L. and Prunus sargentii Rehder*) were collected from the vicinity of gold veins and the control areas and analyzed by instrumental neutron activation analysis for Au and 34 selected elements. Sampling lines were composed of one slope line parallel to the mineralized quartz-veins and two traverse lines spaced 100 m apart across the veins at 20 m sampling intervals.

From the multi-element data of rock samples (n=9), high values of Au (maximum 2, 030 ppb) spatially correlate with gold-quartz veins. Soil samples (n=36) collected from three sampling lines show higher values of Au (24-825 ppb) whereas soil samples from the control areas have lower values of Au (below 25 ppb). Many plant species collected from the mineralized areas denote high Au contents compared with the same plant species in the control areas, but the ranges of Au values vary among plant species. In a total of n=85 samples of leaves, samples of *Quercus aliena Blume* yielded Au values of 0.7 to 6.8 ppb and samples of *Mallotus japonicus* yielded Au values of 0.9 to 4.1 ppb. Gold contents in Pinus *densiflora Siebold* range from 0.1 to 3.0 ppb. Samples of plants in the control areas yielded less than 0.8 ppb Au. Accordingly, *Quercus aliena Blume* and *Mallotus japonicus* are potential indicator plants. Gold in rocks and soils show strong positive correlations with As, Br, Cr, Mo, Sb and W, whereas correlations between element contents in plants and soils are relatively low probably due to biological migration and mobility of the elements examined depending on the topographic relief.

Distribution of atmospheric total nitrogen and total phosphorus over the western North Pacific and their impact on biogeochemical cycles

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Atmospheric aerosol, rain and fog samples were collected over the western North Pacific Ocean between 29 July 2008 and 16 September 2008 through the KH-08-2 cruise to estimate the atmospheric deposition fluxes of particulate total (organic + inorganic) nitrogen (N) and total phosphorus (P), and to evaluate their impact on the marine ecosystem. Water-soluble inorganic N (IN_{ws}) and total N were analyzed using ion chromatography (Dionex-320) and CHN elemental analyzer (NA-1500, Fisons Instruments), respectively. Oraganic nitrogen (ON) was obtained by subtracting IN_{ws} from TN. Water-soluble inorganic P (IP_{ws}), total inorganic P (TIP) and total P (TP) were analyzed using molybdate blue method. Organic P (OP) and acid-leachable inorganic phosphorus ($IP_{acid\text{-}leachable}$) were calculated from the differences between TP and TIP, TIP and IP_{ws}, respectively.

Ammonium (NH_4^+), nitrate (NO_3^-) and ON in aerosols were found to represent ~62% (6.5 ± 2.4 nmol N m^{-3}), ~24% (2.5 ± 1.2 nmol N m^{-3}) and ~14% (1.5 ± 1.6 nmol N m^{-3}) of total N, respectively. Concentrations of $IP_{acid\text{-}leachable}$, OP and IP_{ws} in aerosols were 0.48 ± 0.42 nmol P m^{-3}, 0.39 ± 0.30 nmol P m^{-3} and 0.09 ± 0.08 nmol P m^{-3}, representing ~50%, ~40% and ~10% of total P, respectively. In comparison, contribution of NH_4^+, NO_3^- and ON in fog (in rain) to total N were ~26% (~72%), ~73% (~23%) and ~1% (~5%), respectively. These results suggest that particle scavenging mechanisms between fog and rain are different (e.g. in-cloud scavenging, below-cloud scavenging and hygroscopic property). Contributions of $IP_{acid\text{-}leachable}$ in fog and rain were ~77% (22 ± 21 μmol P L^{-1}) and ~ 87% (25 ± 35 μmol P L^{-1}) to total P, respectively. Relatively small contribution of $IP_{acid\text{-}leachable}$ of aerosols suggests that $IP_{acid\text{-}leachable}$ could become bioavailable P through the reaction with acidic substances in the atmosphere during transport.

The bioavailable N:P ratio of aerosols and rain was always much higher than 16 (Redfield ratio), which means that the atmospheric input supplies more N than P in terms of phytoplankton assimilation.