

Chemistry of sulphur globules from the acid crater lake of Poás Volcano, Costa Rica

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Sulphur globules have been observed floating on the surface of acid crater lakes, and a few acid thermal springs worldwide. They are sporadically observed floating as yellow patches on the surface of Laguna Caliente, the acidic crater lake of Poás, one of the most active volcanoes of Costa Rica. The location of the globules on the lake surface is determined by the presence and activity of upwelling zones, and by wind circulation. The globules are usually spherical and hollow, with a diameter up to 4-5 mm and a yellow greenish colouration, although a few of them are black or have a metallic lustre.

Sulphur globules collected from the surface of Laguna Caliente on 16 June 2000, were analysed by powder X-Ray Diffraction, Scanning Electron Microscopy (SEM-EDS), Electron Microprobe and Laser Ablation ICP-MS. X-Ray Diffraction analysis indicated the presence of orthorhombic sulphur, but did not detect any sulphides, suggesting that their concentration in the native sulphur matrix is less than 5%. Nevertheless, SEM-EDS analysis detected abundant pyrite (FeS₂) crystals in the matrix of the sulphur globules. Laser Ablation ICP-MS was used to identify trace elements in the matrix and the inclusions. A variety of trace metals were found, including As, Bi, Te, Sn, Tl, Cu, Ni, Se, Sr, Zr, Mo, Cd, Sb, Pb and Fe. Cu, Fe, Mo, As and Bi appear to be preferentially concentrated in the inclusions. S, Se, Sb, As and Te are more or less homogeneously distributed in the native sulphur matrix. On the other hand, certain elements (e.g., Sn) were detected only in some of the sulphide inclusions. These observations point to a systematic distribution of trace elements among the solid phases and suggest the existence of sulphide grains with distinct chemical properties. Collectively, the globules act as metal traps within the lake and provide a record of heavy metal transport to the surface.

The origin of sulphur globules, as described here, has been explained by some workers as being associated with the presence of a subaqueous molten sulphur layer at the bottom of the acid lake, or as the a result of fumarolic gas discharges into the water body. Therefore, detailed chemical and mineralogical information could provide important information on fluid-lake water interaction, the mechanisms of sulphur-forming reactions and other dynamic physico-chemical processes occurring in acid lakes, which might be relevant for volcano monitoring and for environmental purposes.

Reference: María Martínez, Paul Mason, Manfred van Bergen, Erick Fernández, Eliécer Duarte, Eduardo Malavassi, Jorge Barquero, Juan Valdés. 2002. *Chemistry of sulphur globules from the acid crater lake of Poás Volcano, Costa Rica*. Proceedings Colima Volcano International Meeting 2002, Colima, México.