

Chemistry and spectroscopy of iron-sulfate minerals from Iron Mountain, California, U.S.A.

C.N. ALPERS^{1*}, J. MAJZLAN², C. BENDER KOCH³,
J.L. BISHOP⁴, M.L. COLEMAN⁵, M.D. DYAR⁶,
R.B. MCCLESKEY⁷, S. C. B. MYNENI⁸,
D.K. NORDSTROM⁷ AND P. SOBRON⁹

¹U.S. Geological Survey, 6000 J Street, Sacramento, CA 95819, USA (*correspondence: cnalpers@usgs.gov)

²Albert-Ludwig-University of Freiburg, Freiburg, Germany (juraj.majzlan@minpet.uni-freiburg.de)

³University of Copenhagen, Frederiksberg C, Denmark (cbk@life.ku.dk)

⁴SETI Institute, Mountain View, CA, USA (jbishop@seti.org)

⁵Jet Propulsion Laboratory, Pasadena, CA, USA (max.coleman@jpl.nasa.gov)

⁶Mt.Holyoke College, South Hadley, MA, USA (mddyar@amherst.edu)

⁷U.S. Geological Survey, Boulder, CO, USA (rbmccles@usgs.gov, dkn@usgs.gov)

⁸Dept. of Geosciences, Princeton Univ., Princeton, NJ, USA (smyneni@princeton.edu)

⁹Universidad de Valladolid, Valladolid, Spain (psobron@iq.uva.es)

The Iron Mountain mining district, in the Klamath Mountains of northern California, hosts extremely acidic mine waters and a wide array of associated iron-sulfate minerals. The Fe–S molar ratio (Fe/S) is an important factor in determining both the pH of weathering solutions and the mineralogy of iron-sulfate weathering products. The excess of S in the stoichiometry of pyrite (Fe/S = 1/2) leads to abundant sulfuric acid upon its oxidation. A systematic relation was found between the pH of the mine water, which ranged from –3.6 to +2.4, and the Fe/S of Fe³⁺-sulfate weathering products, including rhomboclase, copiapite group minerals, coquimbite, römerite, voltaite, and jarosite group minerals. Various spectroscopic methods have been applied to sulfate minerals from Iron Mountain, adding to databases that are used for terrestrial and extra-terrestrial exploration using remote sensing techniques. Data will be presented for the following types of spectra: visible near-infrared (VNIR) reflectance, Fourier-transform infrared (FTIR) transmission, sulfur K-edge X-ray absorption near-edge structure (XANES), Mössbauer, and Raman.

Origin of metabasites from the Higher Himalayan Crystalline Nappes, Kaghan Valley, Pakistan

U. ALTENBERGER¹, F.D.H. WILKE¹ AND R. RHEINISCH²

¹University of Potsdam, Department of Geosciences, Karl-Liebknecht Str. 24-25, 14476 Potsdam, Germany (uwe@geo.uni-potsdam.de, fwilke@geo.uni-potsdam.de)

²MFWK Brandenburg, Dortustr. 36, 14467 Potsdam

Metabasites from the Higher Himalayan Crystalline Nappes, south of the Indus Suture (Indian Plate) were sampled in the Upper Kaghan Valley, Pakistan. Investigations are taken in order to estimate its protoliths, tectono-metamorphic evolution, age relationship among each other and among lower grade series to the south.

The mafic rocks are part of metapelitic and calcschist-rich cover units and occur as retrogressed eclogites as well as amphibolites. Metamorphic degree and fabric are strongly heterogeneous. Some metabasites contain inherited magmatic fabrics, resembling gabbroic precursors. Grain size ranges from very fine to really coarse. Garnet in metabasites from the metapelitic cover looks anhedral, poikilitic and zoned. In contrast, garnet from metabasites of the calcschist-rich cover is free from inclusions and optically unzoned. Omphacite proves a few eclogites, however in most cases omphacite is absent or retrogression to diopside, hornblende and plagioclase consumed all HP pyroxenes.

Geochemically, the samples show a strong consistency independent of fabric and metamorphic grade. Assuming magmatic precursors, they are all of basaltic to andesitic composition and part of the tholeiitic series. They are characterized by low mg# values and low Cr- and Ni-concentrations due to a large degree of olivin fractionation. Normalization to MORB reveals negative Nb- and Ti-anomalies, which are typical for arc-magmatism and some flood-basalts. However, high V and Ti concentrations and Ti/V ratios >20 reject the interpretation of a subduction-related melt genesis. The samples are characterized by moderate chondrite-normalized LREE enrichment (La/Yb 5 - 10). The HREE concentrations do not indicate residual garnet in the source. Therefore, melting in the stability field of spinel-lherzolite is more likely. The PRIMA-normalized enrichment of compatible elements shows similarities to E-MORB and continental flood-basalts, too. In relation to E-MORB the metabasites are depleted in K, Sr and P. Summarizing, all metabasites are similar in composition and comparable to continental flood basalts and to lower grade mafic rocks further to the south.