Teaching mineralogy in the context of the rock cycle

C.W. CARRIGAN

Olivet Nazarene University, Bourbonnais, IL 60914 USA (ccarriga@olivet.edu)

Within the geology curriculum, a mineralogy course is often taken between introductory courses and upper level courses such as petrology, structural geology, etc. Ideally serving as a bridge to advanced material, instead it may function as a 'weed-out' course, causing some students to abandon geology as a major and career. Several reasons likely cause this, but a critical reason is the required mastery and integration of background knowledge from both geology and chemistry. However, introductory geology courses focus on physical processes with little reference to chemical concepts, and introductory chemistry courses focus on gases, liquid solutions, electronic structure, and chemical reactions, with little reference to crystalline solids, espcially silicates. As such, these two fields are not readily integrated in students' minds. I suggest that this disconnect is best overcome by teaching minerals within their petrologic context, rather than in the traditional format of anionic groups. The rock cycle provides a thread throughout the course that can be used to weave new crystalline chemistry concepts together with knowledge acquired previously in physical geology. Students are able to continuously refer to, draw from, and expand their understanding of introductory while learning new mineralogical concepts. That is, that the rock cycle serves as a better scaffold from which to attain new and deeper understanding of the subject matter than anionic groups. I begin with minerals that commonly occur in silicate igneous rocks, then discuss those that occur in hydrothermal veins, those produced by alteration near the Earth's surface, minerals common in aqueous precipitates, and end with minerals common in metamorphic rocks. Several advantages to the method include: 1) better understanding of common mineral associations and how minerals are produced by geologic processes; 2) increased student engagement; 3) it allows easier connectivity with previously learned material; and 4) it allows the instructor to spiral important content by reviewing mineral groups and deepening understanding of them in a new geologic context. Some difficulties include: 1) deciding when to discuss certain minerals (e.g. fluorite); 2) deciding how to weave in fundamentals; 3) deciding on an appropriate depth for certain topics (e.g. amphiboles); 4) students may acquire misinforation about minerals being restricted in occurrence (e.g. calcite); and 5) students may find mineral formulae more difficult to memorize.

Geochemistry of waters close to abandoned As-Au and Sb-Au mines from Valongo, northern Portugal

P.C.S. CARVALHO, A.M.R. NEIVA AND M.M.V.G. SILVA

Department of Earth Sciences, Geosciences Centre, University of Coimbra, 3000-272 Coimbra, Portugal (paulacscarvalho@gmail.com, neiva@dct.uc.pt, mmvsilva@dct.uc.pt)

The Valongo area lies about 18 km at east of Porto, in the Dúrico-Beirão region, northern Portugal. Variscan folding gave rise to the Valongo anticline, which comprises from Cambrian to Carboniferous metasediments and is limited at southwest by the Porto-Tomar-Cordoba shear zone and at northeast by a late-D3 biotite>muscovite granite. The As-Au quartz veins from Banjas outcrop on the eastern limb of the anticline, filling N10-30°W faults and are hosted by Llanvirnian-Llandeilian black shales. The Sb-Au quartz veins cut the western limb of the anticline, filling mainly NE-SW and N-S faults and are hosted by Cambrian metasediments. The As-Au quartz veins consist of quartz, arsenopyrite, pyrite, pyrrhotite, chalcopyrite, pyrargyrite, sphalerite, galena, boulangerite, tetrahedrite, bournonite, glaucodote, electrum, gold, marcasite, siderite, calcite, goethite, covellite, scorodite and jacobsite. The Sb-Au quartz veins contain quartz, cassiterite, wolframite, arsenopyrite, pyrite, pyrrhotite, marcasite, sphalerite, chalcopyrite, galena, boulangerite, jamesonite, electrum, tetrahedrite, fuloppite, zinkenite, berthierite, stibnite, gold, ankerite, siderite, calcite, dolomite, schafarzikite, apuanite, valentinite and cervantite. The As-Au and Sb-Au mines were exploited intermittently since roman times to late 20th century and produced 1903 t of Au, 1974 t of Ag and 12, 000 t of Sb ore containing 2 t of Au, respectively. Waters close to the As-Au mine contain up to 6.96 µg/l Sb and 63.7 µg/l As, whereas those close to Sb-Au mines contain up to 2138 µg/l Sb and 1526 µg/l As. The former and latter waters have pH values ranging from 3.4 to 6.6 and from 3.5 to 6.7, respectively. Most waters close to the As-Au mine tend to have the lowest pH values, mainly due to pyrite oxidation in black shales. Calcite from As-Au and Sb-Au quartz veins causes an increase in the pH of water. In waters related to Sb-Au mines, Sb (V) has a higher content than Sb (III) and some waters have a higher As (III) than As (V). Therefore, in these waters As is in a more toxic form than Sb. Most waters are contaminated and must not be used for human consumption, but they may be used for agriculture.