Experimental determination of pyrite dissolution rate in acidic media at 21° to 61°C

JUN DENG[1,2], QINGJIE GONG[1,2], LIQIANG YANG[1,2],
QINGFEI WANG[1,2], JING ZHANG[1,2] AND
WANMING YUAN[1,2]

[1]State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences, Beijing, 100083, China (djun@cugb.edu.cn; qjiegong@163.com)
[2]Faculty of Earth Sciences and Resources, China University of Geosciences, Beijing 100083, China

The dissolution of pyrite is important in the formation of acid mine drainage. The dissolution rates of pyrite were experimental determined in the laboratory at 21° to 61°C using short-term batch experiments. The rate experiments were performed on crushed, pretreated and sieved size-fractions of pyrite sampled from Dongguashan large copper deposit in Tongling district, Anhui province, China. Particles of pyrite between 20 and 40 mesh were used at 35°C and between 40 and 60 mesh at 21°, 34°, 52° and 61°C. Dissolution occurred in HCl aqueous solution at pH=2 in contact with air at room pressure. Five to six samples were collected at different reaction time, half to twelve days, in each temperature and were analyzed for iron concentrations using colormetry with precision less than 5%.

The relationship of iron concentration in solution with the reaction time is linear at each temperature, which indicates the pyrite dissolution was at far from equilibrium state. The dissolution rates were calculated by the equation: $R=[dC/dt]\times[M/A]$, where $[dC/dt]$ was calculated in iron concentration-reaction time diagram by linear regression, M represents the mass of reaction solution and A is the total geometric surface area of the reaction pyrite particles. The determined dissolution rates are $2.59\times10^{-9}\mathrm{mol\cdot m^{-2}\cdot s^{-1}}$ at 35°C, and 2.12, 3.94, 11.0 and 12.4 $\times10^{-9}\mathrm{mol\cdot m^{-2}\cdot s^{-1}}$ at 21°, 34°, 52° and 61°C respectively. Thses slow dissolution rates derived the activity energy of the pyrite dissolution reaction is $40.3\mathrm{kJ\cdot mol^{-1}}$ by Arrheius equation, which indicates that the pyrite dissolution is a surface controlled process at far from equilibrium state. These results can be used to evaluate the quantity of the dissolved pyrite to the acid mine drainage in Dongguashan large copper deposit.

A crack in the lithosphere cannot Hawaii make: Geodynamics and mantle geochemistry

DONALD J. DEPAOLO

Department of Earth and Planetary Science, Univ. California, Berkeley, CA 94720 (depaolo@eps.berkeley.edu)

There may be some issues that can be raised concerning the existence of mantle plumes, but one that cannot be ignored is the high rate of magma production far from plate boundaries, and in many cases, beneath thick lithosphere. This is not explained by lithosphere weakness; volcanism occurs where magma is produced by active mantle processes, not where lithospheric weakness “allows” magma to come up. Exceptions to this rule, if any, involve trivial amounts of magma, such as the tiny seafloor volcanoes on the western Pacific seafloor. Adding pyroxenite and water to lherzolite to increase the fertility of hotspot mantle does not remove the requirement for active upwelling and elevated temperature. Hotspot longevity requires that fresh mantle be continually brought into the melting region.

Improving geodynamic models of mantle plumes are allowing more information to be gleaned from their geochemistry. In Hawaii the thick lithosphere allows only the hottest, axial part of the plume to melt. Consequently, the geochemical structure observed is attributable to the base of the mantle – either the CMB or the top of a dense layer; virtually none of the entrained mantle material melts. Some plume components, especially ^{3}He, could come from the core. Another challenge is to deduce plume structure from the volcanic output, which requires models for magma production within the plume as well as magma mixing prior to eruption. These models are still crude, but are helpful for constraining plume structure and source characteristics.

Longstanding issues about plume sources and mantle dynamics still revolve around the contrasts between MORB and OIB geochemistry, the roles of crust-mantle versus intra-mantle differentiation, and the existence of primordial mantle structure. The relative enrichment and heterogeneity of OIB sources is generally identified with recycled lithosphere. The origin of the MORB reservoir is more mysterious, but could be explained as recycled, incipiently-depleted sub-lithospheric oeanic mantle produced as a result of the presence of water in both MORB and hotspot magma sources.