The origin and production of CO2 and H2 in mid-ocean ridge magmatic systems

Speaker : Prof. John Holloway
Affiliation : Arizona State University
Date & Time : 10:30 - 12:00 Sep 25, 2009 on Friday
Place : Earth Science Bldg. 5F #503 COE Seminar Room
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Abstract:

Fluids sampled in seafloor hydrothermal system high temperature vents contain significant quantities of CO2 and H2. The purpose of this presentation is to discuss the origin of those volatiles. The H2 is produced by reaction of dissolved H2O with FeO, which is oxidized to Fe2O3. This talk focuses on CO2 production.

The volatile content of mid-ocean ridge basalt (MORB) magmas erupted on the seafloor is measured by analyzing MORB glasses. Major volatiles are CO2 (100-400 ppm) and H2O (1000-4000 ppm). Comparison of these concentrations with the measured solubility in MORB magma demonstrates that the magmas are oversaturated at the eruption depths. The evolved volatiles are rich in CO2 due to their low solubility compared to H2O.

Measurements of the Fe3+/Fe2+ ratio in MORB glasses allows calculation of oxygen fugacity (fO2) in the magma. The measurements show that the magmas are slightly too oxidizing to have been in equilibrium with graphite or diamond. However MORB magmas have undergone significant olivine fractionation during ascent, and the primary MORB magma would have been in equilibrium with graphite or diamond. Working backward from the MORB glass composition allows modeling of the magma history from initial melting, to fractional crystallization on ascent and in the ridge axis magma chamber.

This allows estimation of the total production of CO2 by MORB, which if it has been constant for the last 3 billion years would account for the estimated CO2 abundance in the atmosphere, oceans and carbonate rocks on Earth.