THERMAL AND PH CONDITIONS DURING HYDRATION OF AMORPHOUS SILICATE SMOKES

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Introduction: Amorphous silicate phases (nm-µm-sized) have been observed in an increasing number of primitive meteorites, e.g. [1-8]. During previous hydration experiments with Mg-Si-O smokes, sub-millimeter bubbles appeared immediately following the addition of water [9-10]. Further, the density of bubbles seems to be related to the Mg:Fe ratio of the silicate smokes. In an attempt to address the hypothesis that these are H_2 bubbles forming as a result of serpentinization, we measured the pH and temperatures of a series of hydration experiments using mechanical mixtures of Mg-Si-O and Fe-Si-O smokes (Mg-Si-O from Oct 2003 and Fe-Si-O from Sep 2003). Distilled water was added to the smokes in a clear glass crucible and the pH and temperature were measured with an OakTron pHTestr30 meter every 10s for 30min. Room temperature was also measured at every time step. Several Mg:Fe ratios and smoke:water ratios were measured (Fe only: 40mg:4mL, 40mg:2mL, 40mg:1mL, and 20mg:1mL; Mg only: 20mg:2mL; Mg+Fe mixtures: 10mg:40mg:5mL, 10mg:40mg:2.5mL, 10mg:20mg:3mL, and 10mg:20mg:1.5mL).

Results: Generally pH and temperature during hydration of silicate smokes is very strongly dependent on composition; smoke:water ratio plays a minor role. The higher the Mg:Fe ratio, the higher the reaction temperatures and the more alkaline the solution will become. These reactions are extremely variable. Although the pure smoke batches were fairly consistent, 2-3°C difference in reaction temperatures was observed between batches of the same Mg:Fe:water ratio. This could be due to incomplete mixing of the smokes.

Mg-Si-O smokes in contact with distilled water show a short-lived temperature increase of 1-2°C, with higher temperatures correlated with higher Mg:Fe ratios. After ~3 minutes, the temperature achieves a maximum and starts to drop back down to room temperature and even fell below, suggesting a endothermic reaction. This is different than our preliminary results which showed a temperature increase for over 5 min [9]. The pH is strongly affected by composition. The higher the Mg:Fe ratio, the higher the pH with hydration of pure Mg-smoke resulting in a maximum pH of 10.8, consistent with serpentinizatio reactions. Fe-Si-O smokes in contact with distilled water showed a very different behavior from that of the Mg smokes. Hydration of the Fe-smokes exhibited a change in temperature of less than 2°C, even after 2 hours. The pH was overwhelmingly acidic with the hydration of pure Fe-smoke resulting in a minimum of 5.3.

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