

Dissolved Fe in the Western Atlantic Ocean: Distribution, sources, sinks and cycling

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Iron (Fe) plays a key role in the regulation of primary production and dinitrogen fixation in large parts of the world oceans. Because there is an increasing urgency to understand the role of the oceans in global climate, it is paramount that we understand the biogeochemical cycle of bio-essential elements such as Fe. Despite this recognized importance there is still limited knowledge of the sources, sinks, chemistry and internal cycling of Fe. To fill this gap in our knowledge, the distribution and organic speciation of dissolved Fe (DFe) have been measured during three Dutch GEOTRACES cruises. Together, these cruises form a comprehensive, high resolution, full-depth section through the western Atlantic Ocean from Iceland to 58°S. In this presentation we will evaluate the distribution of DFe and its speciation using many other parameters such as dissolved inorganic carbon, total alkalinity, pH, dissolved oxygen, fluorescence, the macronutrients phosphate, nitrate and silicate and trace elements like dissolved aluminum (DAL) and dissolved manganese (DMn), to understand the processes that determine the distribution of DFe.

The influence of CO₂ on phase relations at Mount St. Helens

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Volatile components play a fundamental role in the ascent and eruption of silicic arc magmas. Although the effect of water on phase relations in these systems is well-studied, CO₂ is also present and may at times be abundant, for example, during instances of gas fluxing. Recent work on melt inclusions from Mount St. Helens suggests CO₂ may exert a strong influence on both depths of vapor saturation and shallow crystallization [1].

To this end, we have performed a series of experiments at shallow crustal pressures in rapid-quench cold seal pressure vessels. Experiments were designed to simulate equilibrium crystallization at depths between the magma chamber and the surface. Run temperatures (880 °C), pressures (<3 kbars), and fugacities (NNO+1) are constrained by natural erupted products, while fluid compositions vary from pure H₂O to XCO₂ = 0.5. This work builds on previous experimental studies of phase equilibria at Mount St. Helens [e.g. 2, 3].

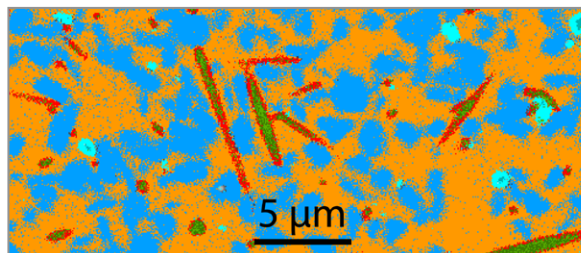


Figure 1: Phase map produced by PARC (880 °C, 500 bars).

High-resolution spectral maps allowed for detailed characterization of run products. Maps were acquired on a Field Emission Gun SEM and processed using a novel software program for automated **PhAse Recognition and Characterization (PARC)** [Fig. 1]. PARC enabled rapid identification of sub-micron crystals and compositional analysis of all phases by quantitative EDS. Our results shed light on the conditions of crystallization and melt inclusion formation at Mount St. Helens, with implications for the volatile budgets of arc magmas.

[1] Blundy *et al.* (2010) *EPSL* **290**, 289–301. [2] Rutherford *et al.* (1985) *JGR* **90**, 2929–2947. [3] Gardner *et al.* (1995) *BV* **57**, 1–17.