Evolution of a maturing arc system: The west-central Isthmus of Panama

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Geochemical data from the Cordilliera de Panama documents the evolution magmatism and oceanic plate interactions over the past 90Ma. Three geochemical associations are observed on the basis of trace element characteristics and ages: (i) Oceanic basement of the Caribbean Large Igneous Province (CLIP) displaying either flat trace element patterns or OIB signatures, CLIP rocks with an arc signature are rare. (ii) The Chagres Igneous Complex (66-45 Ma, Ar-Ar mineral ages) and (iii) a series of younger, Late Cretaceous to Early Tertiary mafic complexes with arc-tholeiitic trace element signatures (variably enriched in Cs, Ba, Rb, K, Sr). LILE/HFSE ratios display arc-type patterns, suggesting an origin from subduction below a CLIP oceanic plateau. Miocene (20-5 Ma) andesites from discrete volcanic centers across the Cordilliera de Panama display a progressive enrichment from a tholeiitic to a more uniform medium-K arc character. This type of arc magmatism ceases around 5 Ma, followed by adakite volcanism (<2 Ma), which represents the youngest magmatism in Panama.

This evolution in magma sources through time can be interpreted in terms of a 2-stage process. 1. An early arc source that likely involved (i) enriched Galapagos mantle (plume or lithosphere) and (ii) typically depleted asthensphere. 2. The composition of the mantle wedge became progressively more homogeneous through time, either due to mixing of the two sources or by replenishment with undepleted mantle from the back arc. One possible cause for initiating this change in mantle sources could be tectonic re-arrangement after the break-up of the Farrallon plate around 28 Ma.

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In-situ X-ray synchrotron high-pressure measurements of magnetite

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Introduction

Magnetite is a ferrimagnetic inverse spinel where the tetrahedral positions are occupied by Fe^{3+} and the octahedral sites contain equal amounts of Fe^{2+} and Fe^{3+}. It occurs in the earth crust and the upper mantle and is also an important material in industrial applications such as data storage.

Experimental methods

For our experiments, magnetite-powder was mixed with vaseline to obtain hydrostatic pressure and sodium chloride was added to act as an internal pressure standard. This mixture was filled into a boron-resin cube. The measurements were carried out at the multi-anvil press MAX80 at the HSYLAB in Hamburg using “white” synchrotron beam. The pressure was increased stepwise up to 4.5 GPa.

The data were evaluated with the Rietveld-method using the GSAS / Expgui-software suite to obtain the cell parameters of the magnetite and the pressure standard.

Results

With inreasing pressure the volume of the unit-cell decreases. At higher pressures the slope declines slowly. Further evaluation of the data will derive the bulk modulus of magnetite using the 3rd order Birch-Murnaghan equation of state.

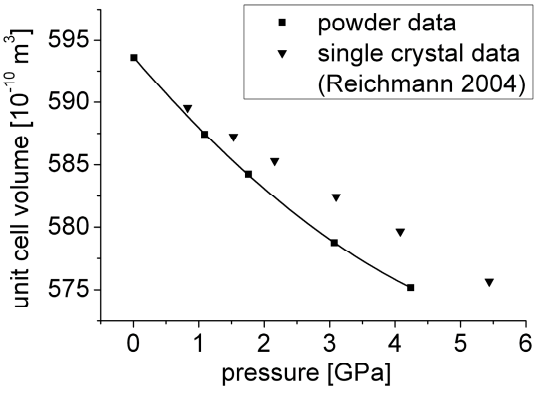

Figure 1: Volume change under pressure

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