Phase relations and compression of FeSi and FeNiSi Alloys: Implications for silicon content of the core

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The density of the core is about 2-5 weight % lower than the density of pure Fe at the core conditions, indicating the presence of low atomic weight components (such as H, C, O, Si, or S) [1]. Solar abundance suggests that Ni which is denser than Fe is expected to exist in the core. Si is a major candidate for the light element in both inner and outer cores because it is one of the most abundant elements in the Earth. Here, we report the phase relations and compression behaviors of Fe 3.4wt%Si alloy and Fe 9.8wt%Ni 4wt%Si alloys.

A double sided laser heated diamond anvil cell (DAC) with beveled diamond anvils was used for study of the phase relations and compression of the alloys. A sample foil was sandwiched in thin layers of NaCl, which was worked as a pressure-transmitting medium, and an internal pressure standard [2]. *In situ* X-ray diffraction experiments were carried out using the synchrotron X-ray at the BL10XU beam line, SPring-8. The results on Fe 3.4 wt% Si alloy revealed that fcc and hcp phases coexist up to 104 GPa, whereas the hcp phase is stable at higher pressures at least up to 3600 K at 242 GPa and to 2400 K at 257 GPa. EOS's for the Fe-9.8 wt% Ni-4.0 wt% Si and the Fe-3.4 wt% Si alloys were investigated at room temperature up to 374 GPa and 252 GPa, respectively. The compression curves are fitted to the third order Birch–Murnaghan EOS with the zero–pressure parameters: K_0 = 167(36) GPa, and K'_0 = 4.7(4) for hcp–Fe-9.8 wt% Ni-4.0 wt% Si and K_0 = 196(20) GPa, and K'_0 = 4.3(2) for Fe-3.4 wt% Si.

The present compression data on the Fe-9.8 wt% Ni-4.0 wt% Si and the Fe-3.4 wt% Si alloys combined with the previous data on FeNi and FeSi alloys [1, 3] and the core density of PREM revealed that the inner core likely posseses an hcp structure with a composition of Fe 82-85 wt. %, Ni10 wt. %, and Si 5.4-7.7 wt. % if the inner core contains nickel about 10 wt % which is close to the chondritic abundance. The present silicon content of the core is greater than that estimated by previous workers.

[1] Mao *et al.*(1990) *J. Geophys. Res*. **95**, 21737-21742. [2] Fei *et al*. (2008) *Proc. Natl. Acad. Sci. USA*. **104**, 9182-9186. [3] Hirao *et al*. (2004) *Phys. Chem. Min.* **31**, 329-336.

Magmatism in the Tsagaandelger, East Mongolian volcanic belt: Petrological and isotopic constraints on Mesozoic geodynamic setting

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The vast territory of Mongolia lies in the heart of the Central Asian Orogenic Belt, one of largest provinces of the Phanerozoic continental growth on Earth [1] We present new petrographic, geochemical and Sr–Nd isotopic analyses on Mesozoic igneous rocks emplaced in Central Mongolia. The Mesozoic igneous suites, those exposed in the Tsagaandelger area, pass upwards from alkaline series trachytic rocks and overlain by tuffaceous sediments. Those are intruded by calc alkaline leucocratic granites and covered by Late Mesozoic calc alkaline bimodal volcanic rocks consisting of basalts and rhyolite.

Alkaline series volcanic sequences were erupted in Early-Middle Triassic (241 Ma) and characterized by LILE and LREE enrichment and significant Nb-Ta depletion. Rocks have weakly enriched initial $^{87}Sr/^{86}Sr$ ratios of 0.705 to 0.706 and positive ε Nd(t) values (0.7 to 4).

The crystallization age of intrusive rocks is 231 Ma. The majority of samples is slightly peraluminous and can be classified as granite, including monzogranite, granodiorite and aplite. Granites are characterized by near-zero ε Nd(t) values (0.7 to 2) and tetrad effect in their REE distribution patterns.

Further Cretaceous volcanic sequences have lower contents of LILE and higher contents of HFS and REE, comparing with Triassic volcanic sequences. The Cretaceous volcanic rocks have the initial $^{87}Sr/^{86}Sr$ ratios between 0.705 and 0.719 and near-zero ε Nd(t) values (-0.7 to 1.6).

Trace element geochemistry indicates that Mesozoic volcanic rocks from the studied area are arc related. The Triassic volcanic and plutonic rocks could be emplaced in active continental margin settings. Post collisional extensional regime could be started with Early Cretaceous volcanism. Moreover, the mass balance calculation suggests that the all Mesozoic volcanic and plutonic rocks were derived from sources composed of more than 80% juvenile mantle-derived component. Thus, our new data provide evidence for a significant production of juvenile crust, and hence growth of the continental crust, in the Phanerozoic.

[1] Jahn *et al.*, (2004) *Jour. Asian Earth Sci.* **23** 629–653.