

Structure and stability of nickel hydroxide at high T-P conditions

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Nickel hydroxide, Ni(OH)₂, belongs to the CdI₂-type, layered hydroxide family M(OH)₂ (M = Mg, Ca, Ni, Co, etc.) and is of interest from the crystal-chemical viewpoint, as it provides a model structure for studying hydrogen-mediated interatomic interactions. M(OH)₂ phases are also interesting for studying Earth's deep water cycle. Though uncommon in the deep Earth, they are present as component units in the structures of many hydrous minerals (such as hydrous magnesium silicate phase E), which are potential hosts for water in the mantle. In addition, Ni(OH)₂ is a cathode material in Ni-based rechargeable alkaline batteries. Thus studying the structure and stability of Ni(OH)₂ at various conditions is of significance both geologically and for its practical applications.

In this study, using *in situ* time-of-flight neutron and energy-dispersive synchrotron X-ray diffraction, we have examined the structure and stability of nickel hydroxide at temperatures up to 623 K and/or pressures up to 8 GPa. To avoid the large incoherent scattering of neutrons by hydrogen, a deuterated sample Ni(OD)₂ was synthesized and used for neutron experiments. For synchrotron experiments, both Ni(OH)₂ and Ni(OD)₂ were measured, allowing studying the H/D isotopic effects. Rietveld analysis of neutron data and peak fitting of synchrotron patterns allowed determination of coefficients of thermal expansion, bulk moduli and other thermoelastic parameters. Moreover, the atomic positions and atomic displacement parameters, particularly of D, have been obtained, and the role of hydrogen-mediated interatomic interactions in the mechanisms of compression, thermal expansion and phase stability of nickel hydroxide are discussed. These results are also compared with those of other M(OH)₂ phases to determine the structural and stability systematics of the M(OH)₂ family.

Recycling of lower continental crust in an intra-continental setting: Mineral chemistry and oxygen isotope insights from websterite xenoliths in the North China Craton

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A suite of websterite xenoliths entrained by the Early Cretaceous Feixian basalts in the eastern North China Craton provide direct evidence for recycling of dense lower continental crust in an intracontinental setting. Petrographic observations indicate that olivines within the xenoliths are replaced by orthopyroxenes, which in turn are replaced by clinopyroxenes. The $\delta^{18}\text{O}$ values of olivines from websterite xenoliths vary from 7.1 ‰ to 7.6 ‰ ($\pm 0.4\text{‰}$, 2SD). The Ni contents of the orthopyroxenes and clinopyroxenes in the websterites are much higher than those of mantle-derived harzburgite and lherzolite xenoliths within the Early Cretaceous high-Mg diorites, and of phenocrysts within the Late Cretaceous basalts. Clinopyroxenes in the websterite xenoliths have high ⁸⁷Sr/⁸⁶Sr ratios (0.70862–0.70979). These findings, together with high initial ⁸⁶Sr/⁸⁷Sr ratios (0.70977–0.70990) and low Nd(t) values of the host basalts (–13.1 to 13.4) [1], indicate that the melt, which modified the lithospheric mantle, could be derived from partial melting of the delaminated eclogitic continental crust. Therefore, our study shows that the intracontinental recycling of lower continental crust is a key factor not only to result in chemical and isotopic enrichment in the subcontinental lithospheric mantle [2], but also to result in compositional variations of intracontinental basalts [1, 3].

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[1] Gao *et al.* (2008) *Earth Planet. Sci. Lett.* **270**, 41–53. [2] Xu *et al.* (2008) *Earth Planet. Sci. Lett.* **265**, 123–137. [3] Liu *et al.* (2008) *Geochim Cosmochim Acta* **72**, 2349–2376.