

Transportation of water in subduction zones

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Purpose and Method

Transportation of water in subduction zones is important for understanding magmatism, metamorphism and seismicity in convergent plate boundaries, and also important for understanding global circulation of volatile components. Dehydration of hydrous minerals in the subducting plate, and subsequent migration of the aqueous fluid are modeled in this study, in order to quantify the water budget in subduction zones. The model describes phase relationships of the hydrous peridotitic and basaltic systems, flow of solid through which the fluid migrates according to the pressure gradient. We compare the model results with the observations such as distribution of volcanoes and seismic structures. The Japan arcs are ideal for this study in terms of variations in subduction parameters, and the amount and the quality of the observations.

Results and Discussion

The model calculation suggests that in NE Japan, nearly all the H₂O expelled from the subducted Pacific plate is hosted by serpentine and chlorite just above the plate, and is brought down to 150 km (Iwamori and Zhao, 2000). Breakdown of the minerals at these depths results in the formation of a fluid column, and results in the initiation of melting in the mantle wedge beneath the backarc. The seismic tomographic studies suggest the existence of such a melting region beneath the backarc. In central Japan, the subducted Philippine Sea plate overlaps the subducted Pacific plate. This geometry causes slow thermal recovery of the subducted Pacific plate, resulting in dehydration reactions at levels (200-300 km) deeper than in NE Japan, and deflection of the volcanic chain towards the backarc side (Iwamori, 2000). The model also suggests that, beneath central Japan, a part of H₂O subducted is carried to depths greater than 300 km by phase-A. In contrast, in SW Japan, where a relatively hot part of the Philippine sea plate (Shikoku basin) subducts, the dehydration reactions are predicted to occur at relatively shallow levels (<100 km depth). The seismic tomographic image supports well the predicted distribution of the fluids beneath the volcanic front to the forearc region (Zhao et al., 2000). Based on the comparison, it is shown that, in most of the subduction zones, water is released from the subducting plate at depths shallower than 200 km, and that the main circulation of water is closed at the shallow level.

References

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Preconcentration and speciation of trace metal elements in environmental waters in Niigata Prefecture, Japan

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The monitoring and determination of trace heavy metal elements in environmental samples is very significant from the viewpoint of environmental protection. The abundances of these elements in environmental waters is very low. Moreover, the toxicity and mobility of trace metal elements in the environment are dependent on the chemical form or species in which it exists. Therefore, the development of an efficient method for the separate determination of each species of target elements as well as the concentration of these elements from matrices is needed. Based on the above-mentioned, (i) the establishment of the efficient method for the preconcentration and speciation of trace metal elements in environmental waters, and (ii) the determination of trace metal elements in environmental waters in Niigata Prefecture by applying the method has been investigated in this work by using the sorbent extraction technology and atomic spectrometric analysis. Consequently, the following matters have been mainly clarified. (1) By using a chelating extraction disk (iminodiacetate type, 0.5mm pore size; 47mm diameter), rare earth elements (REEs) as well as transition metals in environmental waters were quantitatively collected on the disk. (2) Different species of chromium (i.e., Cr(III) and Cr(VI)) in environmental waters were relatively easily separated by the ion-exchange method (i.e., cation-exchange resin for Cr(III) and anion-exchange resin for Cr(VI)). The preconcentration factor was 100 for Cr(III) and 300 for Cr(VI) in this work. (3) The concentration of Cr(III) in the representative river (e.g., Water System of Shinano River) was 0.43-0.44 ng/ml and that in the representative marsh (i.e., Sakata) was 0.29 ng/ml. (4) The concentration of Cr(VI) in Shinano River was 0.04 ng/ml and that in other environmental waters were under detection limit. (5) Different species of arsenic (i.e., As(III), As(V) and DMA) in environmental waters were separated by adjustment of pH in the sample solution and use of the cooling system.