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マントルの熱い指と島弧地殻の進化
Hot fingers and arc crust evolution

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Subduction and arc magmatism are fundamental processes in the evolution of the Earth, because they play crucial roles in the present-day differentiation of earth's materials and are believed to be major sites of continental crust generation that have operated throughout geologic time. Processes of mantle melting and volcanic eruptions along subduction zones are often illustrated by the use of two-dimensional cross-section models of convergent margins. Initially, aqueous fluids released from the subducted oceanic sediments and crust rise into the mantle wedge, lowering the mantle solidus and stimulating magma generation and, ultimately, volcanism at the surface. In addition, the descent of the plate stirs the mantle, bringing a flux of warmer mantle material from greater depth, thermally reinforcing the melt generation process. I review here the structure of the mantle wedge and arc crust beneath the northeast (NE) Japan arc and the Izu-Bonin arc, respectively, and suggest that the third dimension, lying along the strike of the arc, is necessary to understand the actual production of magmas in subduction zones. These arcs are two of the best places in the world to understand the 3-D structure of the mantle wedge and arc crust. In this context, this 3-D structure indicates that magma productivity is not uniform along a volcanic arc. Information about 3D structures have come from independent studies of the mantle wedge and arc crust in the NE Japan and Izu-Bonin arcs, respectively, and common periodic structural variations, having wavelengths of 80-100 km, can be observed in both areas. Thus we suggest here that the 3D thermal structure of mantle wedge has a direct link to the 3D structure of arc crust via production of arc magma within the mantle wedge. The hot fingers models may play an important role in linking the 3D structures within the mantle wedge and overlying arc crust to volcanic eruptions at the surface.

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