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Potential and limitations of deep EM sounding at subduction zones - lessons from the Andes and Central America

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The fluid-melt cycle of subduction zones is a primary target of deep electromagnetic sounding. Several zones of enhanced electrical conductivity may be identified being due to: 1) the subducted, water-rich sediments at the plate tip, 2) intrusion of seawater into the shallow oceanic mantle leading to serpentinization, 3) dehydration-hydration reactions at intermediate depths, 4) melting of the mantle wedge, 5) rise of molten material into magma reservoirs at the base of the crust of the overriding plate and at intermediate density contrasts, and 6) shallow magma reservoirs beneath arc volcanoes.

Obstacles for a successful EM study, however, are numerous, including the huge conductance of the sea and the great depth of some of the involved processes. Furthermore, amphibious experiments are essential to assess the potential high-conductivity zones near the plate boundary.

I report on three regions where large-scale experiments have been conducted in the recent past: the Central Andes of Chile, Bolivia and Argentina, the Southern Chilean Andes and the Central American subduction system of Costa Rica and Nicaragua. The major crustal anomalies in the Central Andes lie in the backarc of the Altiplano-Puna plateau; they are interpreted as an image of large occurences of silicic partial melt. Where this highly conducting layer is absent, the mantle wedge could be resolved at depth of over 100 km. In contrast, South Chile is characterized by structural anisotropy encompassing the entire mid-lower crust and extending until the plate tip, as revealed by offshore data. The anisotropy direction is coincident with the consistent SW-NE alignment of minor volcanic centers and fissures and points to a deeply-fractured crust (feeder dikes?). Individual structures at depth, however, cannot be resolved anymore. This is also the case near the coast in Northern Chile, where induction vectors point even parallel to the coast and the 8 km deep trench.

In contrast, the Central American subduction zone behaves more "normally" and vast zones of very high conductivity are absent here. Again, the most pronounced anomalies are located in the backarc, but it is difficult to construct fluid-melt pathways from the conductivity images, except for Central Nicaragua, where the volcanic arc is underlain by very prominent low-resistivities. An enigmatic sequence of conductors is obeserved in the Nicaraguan backarc, hinting perhaps again at an anisotropic crust.

A very recent study concentrates on the resolution of magma deposits beneath active volcanoes in the Central Andes (e.g., Lascar) and an area of significant ground inflation in the Lazufre area at the Chilean-Argentinian border. First results will be presented and discussed in this contribution.

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