Surface to interior variations of magnetic properties in submarine pillow basalts

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Submarine pillow basalts are supposed to be one of principal contributors to marine magnetic anomalies and their magnetic properties have been thoroughly investigated. In addition, the glassy rinds are used as excellent materials for paleointensity experiments. From the glassy rims to the crystalline interiors many of their magnetic properties varies significantly and Kent and Gee [1994] explained the variation by grain-size dependent alteration of magnetic minerals. The paradox of unblocking temperature above the Curie temperatures and the anomalously high Mr/Ms (above 0.5) observed for submarine pillow basalts are similarly explained based on the hypothesis of grain-size dependent alteration.

A block of pillow basalt collected by a submersible SHINKAI 6500 near the Southwest Indian Ridge was utilized for examining the depth variation of magnetic properties from the surface. A column longer than ten centimeters was cut out perpendicular to the pillow surface, and the column was sliced into thin slabs (2 or 2.5 mm thick). Thermomagnetic analyses indicated that the glassy rim are basically barren of magnetic materials but the inside crystalline basalts deeper than 10 mm from the surface possess titanomaghemites. Hysteresis curves are obtained for the samples by applying a maximum field of 1 T, and it was found that the apparent saturation magnetization increases steadily from the surface to the interior and the apparent coercivity and Mr/Ms have the peak values near the glass rind and crystalline interior boundary.

Although such depth-variation data are similar to the previously published data [e.g., Gee and Kent, 1999], it should be noted that the Curie points are difficult to be uniquely determined and the hysteresis curves show uncommon shapes. Curie points would be distributed over a wide range of temperature, and hysteresis properties are probably governed by magnetostrictive effects.