Multi-scale hydrothermal circulation inferred from detailed heat flow measurements in the Suiyo Seamount Hydrothermal System

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Hydrothermal activity within the caldera of Suiyo Seamount was investigated in detail using manned or remotely-operated submersibles, and by deep-tow imagery and seismic surveys. Hydrothermal regime in the Suiyo-seamount was characterized by a geochemically uniform fluid, shallow reservoir depth, very permeable seafloor, and venting without creating big chimneys. Detailed heat flow surveys were carried out through four research cruises conducted in 2001-2002. Geothermal probes, called SAHF (Stand-Alone Heat Flow) meter, are 1 m in length, and five thermistors were installed at 11-12 cm intervals. Heat flow was highest within the active area. These values were obtained close to black smokers, thus are affected by the venting or very shallow reservoirs. To the east, heat flow is uniform around 4 W/m^2. Since there were no indications of discharge, this area is dominated by thermal conduction and its heat source would be a hydrothermal reservoir capped by some impermeable layer. To the west, we detected very low heat flow values of less than 0.3 W/m^2, only several tens of meters away from the active area. A similar heat flow anomaly was detected in the TAG hydrothermal mound of the Mid-Atlantic Ridge (Becker et al., 1996). We penetrated at 1-2 m away from two isolated active sulfide mounds. At both sites subbottom temperatures were about 40 degC at 10-20 cm depth, then they decreased to about 20 degC at 30-40cm. The temperature reversals suggest a meter-scale hydrothermal circulation, where a hot fluid discharges as a branch flow from the main vent to the mound. An impermeable structure of the mound and a permeable sediment surrounding the mound would make this very local circulation possible. We suggested a multi scale hydrothermal circulation system. It was approximately 2-3 meters scale, and the other with approximately 20-30 meters scale. The former would be driven by a suction created by discrete venting of high temperature fluid, and the latter is a regional-scale circulation which can be described by Darcy's law of flow in porous media. This research is funded by Ministry of Education, Science and Technology through Special Coordination Fund 'Archaean Park' project.