Geophysical Research Abstracts
Vol. 13, EGU2011-12261, 2011
EGU General Assembly 2011

Contribution for heat flow density estimation in a 26 m deep borehole in Reina Sofia Mountain, Livingston Island, Maritime Antarctica

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During the month of January of 2008 a 26 meters deep borehole (Permamodel Gulbenkian 1 - PG1) was drilled on the top of Mount Reina Sofia (275 meters a.s.l.) near the Spanish Antarctic Base of Livingston Island, South Shetland Islands. The borehole was drilled to monitor the temperature evolution with depth for several years and so a thermistor chain was installed at depths of 0.2, 0.4, 0.8, 1.2, 1.6, 2, 2.5, 3, 3.5, 4, 5, 6, 8, 10, 12.5, 15, 17.5, 20, 22.5 and 25 m. With the idea of estimating the heat flow density for the borehole (besides other things, such as reconstructing the ground surface temperature history for the area) cores from it were collected from 1.5 m to 26 m depth. The cores were used to measure thermal conductivity, thermal diffusivity, heat production, porosity, and density in the laboratory. Here we present the values of the thermal conductivity and the thermal diffusivity that were measured in the cores from the borehole and the heat production that was estimated for the geological formations intercepted by it. Seven cores from the borehole were selected to measure the thermal conductivity and the thermal diffusivity. The measured values for the thermal conductivity vary from 2.56 W/mK to 3.28 W/mK while the measured values for the thermal diffusivity vary from 1.09 x 10-6 m2s-1 to 1.58 x 10-6 m2s-1. Both thermal conductivity and thermal diffusivity, on average, increase with depth. Heat production was also estimated for two portions of the borehole: one for the range 2 to 12 m depth and another for the range 12 to 25 m depth. A gamma-ray spectrometer was used to estimate the concentrations of uranium, thorium, and potassium of the cores, from which the heat production per unit volume was calculated. The estimated heat production for the first half of the borehole is 2.218 μW/m3 while for the second portion it is 2.173 μW/m3; these heat production values are compatible with acidic rock types. Thin sections are being prepared to identify the rock types intercepted by the borehole. For the moment heat flow density cannot be estimated because the temperature logs that are being obtained from the thermistor chain show, as it would be expected a strong climatic signal that propagates below the depth of 26 m. However, it is also expected that new temperature data from the borehole to be collected during the field campaign of 2011 will allow estimating the geothermal gradient for the area where the borehole is located and so estimating the geothermal gradient or, at least, estimating lower and upper bounds for the local heat flow density.