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Investigations on the geothermal state of the ICDP COSC-1 well bore

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In 2014 the first well of the Collisional Orogeny in the Scandinavian Caledonides (COSC) ICDP project was drilled near Åre in west central Sweden. The well penetrates the Seve Nappe complex, a result of subduction/exhumation processes during the collision of Baltica and Laurentia $\sim$ 400 Myrs ago (Gee et al. 2010). To gain a more detailed understanding of the geothermal state of fossil mountain belts and cratonic areas, it is necessary to study present-day heat transfer in the earth's crust in appropriate deep boreholes. Constraining the heat transfer requires temperature measurements in boreholes and determination of thermal properties of the rocks present. The specific object of our study is to derive a local thermal model providing the pristine thermal state and quantifying transient effects, i.e. paleoclimatic and convective effects, on the local geotherm.
The outstanding core recovery ($\sim$ 100%) of the 2495.8 m (MD) deep well in combination with extensive wireline logging campaigns provide an exceptional basis for a broad range of core measurements and well log correlations. A total of 105 core samples, representing all major lithologies, were carefully selected for laboratory investigations, such as determining heat capacity, thermal conductivity, and thermal diffusivity.
Density and thermal conductivity were determined for each of the 105 core samples under ambient pressure and unsaturated conditions. The thermal conductivity was measured using the optical scanning method (Popov et al. 1985) providing a first-order estimate of thermal properties along the cores' surfaces. Based on these preliminary measurements, a thermal conductivity profile was constructed, showing a steep increase towards the lower section of the well. For the first $\sim$ 2000 m the average thermal conductivity amounts to 2.5$\pm$0.6 W/(m.K) and increases to 4.1$\pm$1 W/(m.K) in the lower section of the well. In addition, spectral gamma ray logs were used to determine the amount of radiogenic heat production (Rybach, 1988). The integrated heat production within the well is merely low and amounts to $\sim$3.3 mW/m^2. Three temperature logs were measured about one week, one month, and one year after drilling. The observed gradual slowdown in temperature recovery suggests that the latest log was probably measured very close to thermal equilibrium. Furthermore, the latest temperature log appears to show a typical curvature reflecting sudden global warming at the Pleistocene-Holocene transition. Based on the latest temperature log an uncorrected average thermal gradient of $\sim$21 °C/km is tentatively proposed.

References:
Gee, D. G.; Juhlin, C.; Pascal, C.; Robinson, P. (2010): Collisional Orogeny in the Scandinavian Caledonides (COSC). In GFF 132 (1), pp. 29–44.
Rybach, L. (1988): Determination of Heat Production Rate. In R. Haenel, L. Rybach, L. Stegena (Eds.): Handbook of terrestrial heat-flow density determination. Guidelines and recommendations of the International Heat Flow Commission, pp. 125–142.
Popov, Y. A.; Berezin, V. V.; Semenov, V. G.; Korostelev V. M. (1985): Complex Detailed Investigations on the Thermal Properties of Rocks on the Basis of a Moving Point Source. In Izvestiya, Earth Physics 21 (1), pp. 64–70.