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New heat flow data from three boreholes near Bergen, Stavanger and Moss, Norway

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An attempt has been made to reveal the major features of the subsurface temperature distribution in the Fyllingsdalen, the Ullrigg and the Årvollskogen boreholes, which are located near Bergen, Stavanger and Moss, respectively. Based on 2D gravity and magnetic modelling, the lithosphere-scale 2D models have been constructed for the Bergen, Stavanger and Moss areas. All available shallow and deep data have been used to construct these 2D structural models which, therefore, represent a current state of our knowledge of the bedrock structure beneath these three study areas. These 2D models were used during the 2D thermal modelling to understand the thermal regime within the crystalline crust of the study areas.
The results of the 2D thermal modelling demonstrate that a significant decrease of the Earth's surface temperatures during the two last glaciations still affects the subsurface thermal field of the study areas in terms of the reduced temperatures within the uppermost crystalline crust. Tentative palaeoclimatic corrections for the investigated boreholes vary from 21-23 to 26-28 mW/m^2. Besides, the advective cooling due to groundwater flow is an additional factor for the reduction of temperatures within the Bergen and Stavanger areas where the normal annual precipitation is one of the highest in Europe, reaching roughly 4000 mm/year. On the other hand, the influence of the groundwater flow on subsurface temperatures is most likely very low within the Moss area.
According to the results of 2D thermal modelling, the modelled temperatures are higher in the Fyllingsdalen and Årvollskogen boreholes compared to the Ullrigg borehole. This difference is in agreement with the low measured thermal gradient in the Ullrigg borehole which is less than 13.0 °C/km compared to 16.5 °C/km in the case of the Fyllingsdalen borehole and 19.3 °C/km in the Årvollskogen borehole. The differentiation in radiogenic heat production of the crystalline crust is one of the main reasons for the higher measured and modelled temperatures within the Bergen and Moss areas in comparison to the Stavanger area. This resulted in a higher heat flux in the Fyllingsdalen and the Årvollskogen boreholes in comparison with the Ullrigg borehole.