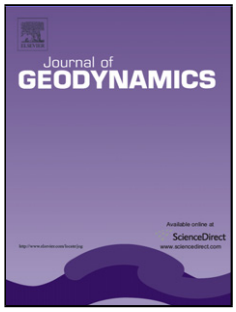


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# A review of surface heat-flow data of the northern Middle Atlas (Morocco)

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## Abstract

We revised thermal data available from water and oil wells in the northern sector of the Middle Atlas region. To avoid biased estimation of surface heat flow caused by advection likely occurring in shallow aquifers, temperature measurements in water boreholes were carefully inspected and selected. The heat flow in the oil wells was inferred by taking into account the porosity variation with depth, the temperature effect on thermal conductivity of the matrix and the pore fluid, together with the contribution of the radiogenic heat production. Moreover, the possible bias in heat flow caused by convection occurring in confined carbonate aquifers was evaluated. The results of heat flow slightly modify the picture reported in previous investigations. The heat flow value over the investigated region is rather uniform (about 80 mW $m^{-2}$) and is similar in oil wells and in water boreholes. Geothermal calculations indicate that such a surface heat flow is compatible with a ~ 70 km thick thermal lithosphere and normal thermal conditions in the asthenospheric mantle.

**Keywords**: Underground temperature; Advection; Carbonate aquifers; Thermal lithosphere

## 1. Introduction

The tectonic setting of Morocco is characterised by two orogenic belts, the Rif-Tell and the Atlas. The former, denoting a southwards direction of tectonic transport, is a thrust-and-fold belt that has deformed from Late Eocene to Quaternary times; the latter is an intra-continental asymmetric system, which formed during the Alpine cycle and comprises the fold-thrust belts of the High and Middle Atlas (Fig. 1).

After a Mesozoic rifting episode affecting the central-north Atlantic and western Tethys, the Atlas chain uplifted, in response to the Cenozoic collision of the African and European plates (Frizon de Lamotte et al., 2009). The Atlas developed over a Variscan continental basement, only slightly thinned during its pre-orogenic evolution, and over two more or less tabular platforms, the Western and Eastern Meseta Paleozoic blocks, characterized by thin or even absent Mesozoic cover and Cenozoic series (Missenard et al., 2006). The Rharb basin, formed by