The Vienna Basin provides a potential for utilizing deep geothermal energy based on isotropic, facial and lithologic features. In reference to the thermal conductivity only a small number of measurement values are available. There exists, however, a huge amount of hydrocarbon well logging in the Vienna Basin. The intention of the investigation was to gain comparative values for the thermal conductivity of various stratigraphic units of the sedimentary fill of the Neogene basin floor as well as the Alpine basement by means of the lithologic properties, porosity and pore content. Electric logs were applied for the Neogene basin fill to determine this parameter. Concerning the higher lithologic variety of the basement a supplementary analytic is required by density-, sonic- and gamma ray logs as well as by cuttings and cores included.

The analysis points out a relationship between the stratigraphic-lithological profiles and the values of thermal conductivity and according to their depth position it enables the calculation of the quantity of the recoverable energy. In general the thermal conductivity increases with the depth due to compaction of the sedimentary sequences (Fig. 8). Consequently, determination of lithology, compaction, porosity and pore content by analysing electric logs provides representative values for the effective thermal conductivity of the Neogene Vienna Basin. This method can be applied if measured laboratory values are only scattered.

To determine the connection between the various stratigraphic units and the thermal conductivity three specific areas of the Vienna Basin were taken which differ regarding the thickness of the sedimentary basin fill and the position of the Alpine basement and reflect the complex structural build-up of the basin (Fig. 7a). Examples of lithologic profiles and related thermal profiles are given from Neogene depression- and elevation areas of the basin choosing the wells Schönkirchen T32 and Zistersdorf UT 2a (Wittstock 2006), where heat can be provided from the Neogene and the basin and the well Luxembourg 2 (Wissel & Wittstock 1983) where the energy recovery is mainly related to Carboniferous Alpine carbonates of the basement. In addition, in the area of the well Luxembourg 2 a thermal anomaly exists (Fig. 7b).

The thermal conductivity of the different stratigraphic units of the basin fill is calculated first in determining the sand/clay-ratio by electric logs. Table 1 to 3 show the proportional share of sand and clay for the relevant stratigraphic units of the three selected boreholes. On the base of this ratio a lithologic formation value is calculated. The connection to the determination of the relative thermal properties is carried out by lithological specific values (Krutovski 1999). The varying effects of the pore fluids on the thermal conductivity are integrated by specific water content parameter (Bcsc 1976). For calculation different values of fresh water and saline conditions are integrated. The assignment of the relevant borefluid occurs by information of drill-steam tests from the boreholes. On account of their intense differing thermal properties compared with the matrix the porefluids can have a considerable influence on the effective thermal conductivity of a sediment layer.

On the fundamental assumption of anisotropy conductivity and pore distribution within the matrix the thermal lithologic properties are calculated by geometric means (Schön & Götzl 2007). For calculating the effective thermal conductivity equation 1 is applied. The depth relevant porosity values are shown in Table 4. The determined effective thermal conductivities are facing literature values (Schön 1983) and are shown in Table 1 to 3. In the Calcarious Alpine basement the Haupttobelstein units, tamed at the wells Schönkirchen T32 and Luxembourg 2 were compared according to the thermal properties. The log analysis and the inclusion of lithologic and isotopic information out of the core and cuttings showed in relation more favourable thermal properties for this formation in the borehole Luxembourg 1 in comparison to Schönkirchen T32.

Interpretation and discussion:

The analysis points out a relationship between the stratigraphic-lithological profiles and the values of thermal conductivity and according to their depth position it enables the calculation of the quantity of the recoverable energy. In general the thermal conductivity increases with the depth due to compaction of the sedimentary sequences (Fig. 8). Consequently, determination of lithology, compaction, porosity and pore content by analysing electric logs provides representative values for the effective thermal conductivity of the Neogene Vienna Basin. This method can be applied if measured laboratory values are only scattered.

References