THE THERMAL REGIME AND GEOTHERMAL ENERGY RECOVERY POTENTIAL OF THE WESTERN CANADIAN SEDIMENTARY BASIN

JONES, F. W., Dept. of Physics, Univ. of Alberta, Edmonton, Alberta, Canada T6G 2J1

Bottom-hole temperature data from petroleum exploration wells have been used to investigate the temperature regime of the Western Canadian Sedimentary Basin. Comparison of the vertical temperature gradients and heat flows across two intervals of the sedimentary section indicates that the thermal regime is strongly influenced by regional groundwater flow on a large scale across the whole width of the basin. Figure 1 gives the difference $\Delta Q = Q_1 - Q_2$ between the heat flow in the upper (mostly clastic) part of the section (Q_1) and the heat flow in the lower (mostly carbonate) part of the section (Q_2). The results indicate reduced heat

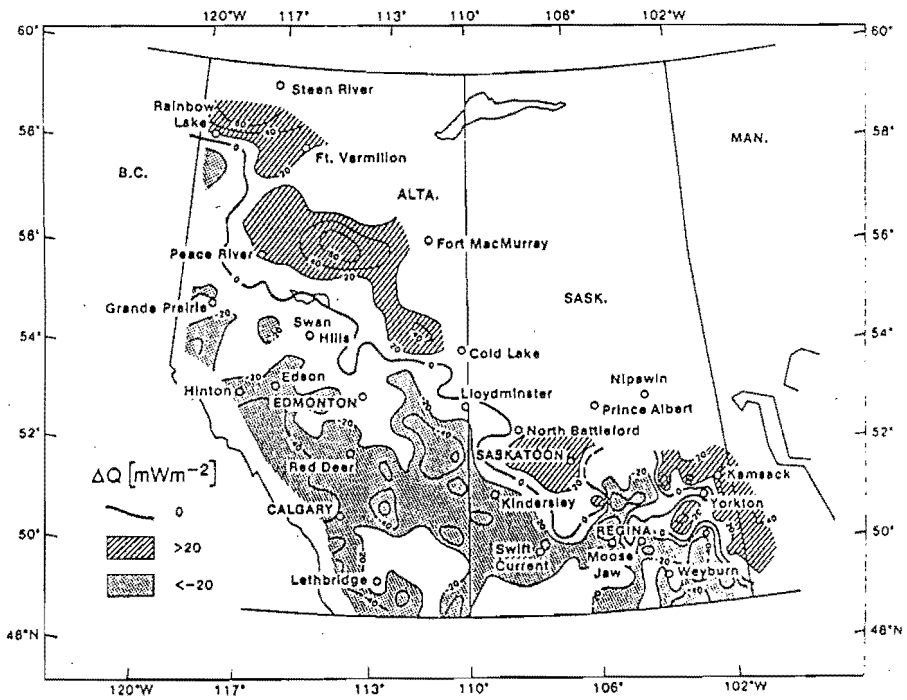

Fig. 1 Contour plot of the differences $\Delta Q = Q_1 - Q_2$ in mW m^{-2} between the estimated average heat flow density values for the Mesozoic + Cenozoic formations (Q_1) and Paleozoic formations (Q_2). Note that negative ΔQ values occur southwest of the $\Delta Q = 0$ line and positive values occur in the northeast part of the basin.

flow through the upper interval in the south and west, and increased heat flow in the upper interval in the north and east consistent with the effect of heat transport by groundwater motion from the recharge areas of the mountains and foothills in the south and west towards the discharge areas of the lowlands to the northeastward.

The perturbation of the temperature regime in the basin means that the temperature at the base of the sediments is not a function of depth only. This is illustrated in Fig. 2 that shows the locations of the 60° C and 100° C isotherms at the Precambrian surface superimposed on the map of Precambrian surface depth contours for Alberta. The isolines are not parallel, and it is seen that conditions for appropriate temperatures for geothermal energy recovery at shallower depths are better in central and northwestern Alberta than in southern Alberta. It is clear that both regional and local hydrodynamics must be considered when exploration for geothermal energy recovery sources is undertaken.

Temperatures, flow rates, and water quality information have been used to investigate the conditions for possible low-enthalpy geothermal energy recovery for three areas in Alberta as indicated in Fig. 2. Regression lines from bottom-hole temperature versus depth plots for the three areas are given in Fig. 3, together with the average gradients. Contour plots of the temperature at 3km depth are given in Fig. 4 a-c for the three areas, and it is

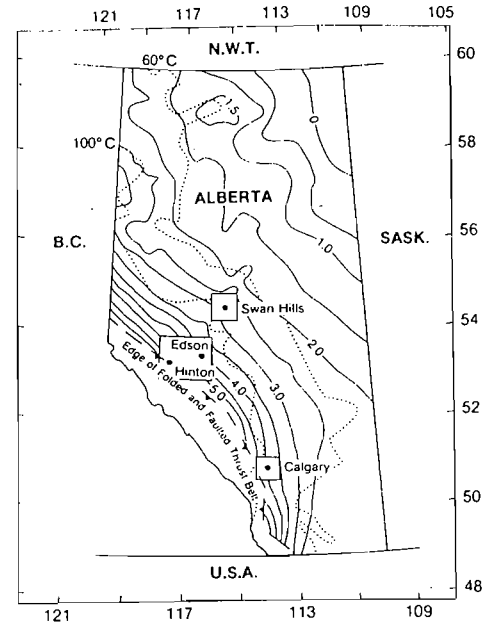

Fig. 2 Isotherms of 60° and 100° C at the Precambrian basement overlaid on the contour map of the subsurface depth to the Precambrian basement. The three areas of detailed study are shown.

seen that the temperatures at this depth are favourable for geothermal energy recovery. The flow rate data and information on amounts of dissolved solids indicate that formations exist in all three areas that are suitable for energy recovery.

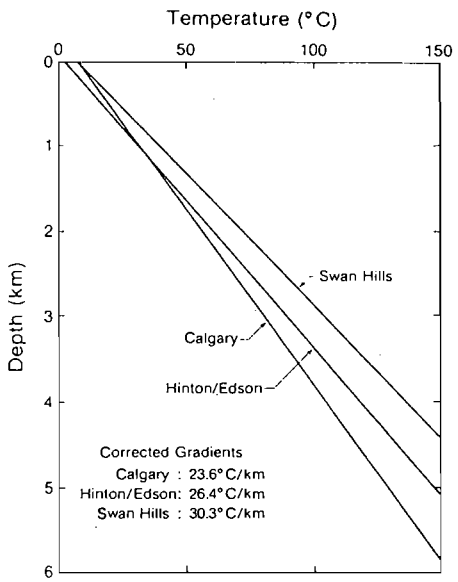

Fig. 3 Regression lines from bottom-hole temperatures vs. depth plots for the three areas.