GEOTHERMICS IN TRANS-PECOS TEXAS: PRELIMINARY FINDINGS

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ABSTRACT

Knowledge of the thermal regime in Trans-Pecos Texas has been slow to accumulate, despite the presence of several interesting natural geothermal phenomena. These occur mainly within the Rio Grande Valley between El Paso and Big Bend National Park. Present limited heat-flow data suggest an increased heat-flow in the river zone, as compared with the high plains to the east. A series of gradients measured here also support this observation.

Current work is concentrated in an area near Hueco Tanks State Park, a few miles east of El Paso, where a shallow drilling program is presently indicating heat-flow values as high as 11 h.f.u.

INTRODUCTION

Geothermal prospecting in Trans-Pecos Texas (that part of the state west of the Pecos River) has been somewhat limited, partly by the remoteness of the country, and partly by the lack of a ready market for the use of any non-electrical grade resource.

Present heat-flow data in West Texas are sparse; up to now, efforts have been mainly concentrated north of the Texas-New Mexico border in defining the thermal characteristics of the Rio Grande Rift. Herrin and Clark (1956) determined the heat-flow in the Permian Basin oilfields to be 1.1 h.f.u., typical of the Great Plains, while the results of Decker and Smithson (1975) in southern New Mexico and West Texas reflect the normal heat-flow of the Basin and Range province. This suggests, as does the surface geology, that Trans-Pecos is a transition zone between these two provinces.

Hot spring activity continues along the Rio Grande south of El Paso, the various occurrences of natural hot water ranging in temperature from about 30°C to nearly 90°C, the latter being on the Mexican side of the river (Henry, 1978). Two hot springs have been developed as small health resorts, and in addition two oil test-holes, drilled in 1965, are now artesian and are used to irrigate the otherwise arid land; the first "commercial" uses of geothermal waters in the area. The springs generally emanate from Quaternary bolson fill, and are almost certainly connected with the north-south trending boundary faults which define the eastern edge of the river valley. This "rim" is marked by fault scarps of Tertiary basalt and ash flows, interspersed with intrusive centers of similar age; the downdropped (west) side is covered by bolson deposits, which gravity modelling has shown to attain a maximum thickness of 1.5km (Mraz, 1977).

Similar graben structures exist further north, in the form of the Salt Flat Graben and Hueco Bolson, east of El Paso, the second of which contains an area under present investigation for geothermal resources. A generalized tectonic map of Trans-Pecos Texas is presented in Figure 1.

CURRENT RESULTS

Work is under way to delineate the regional heat flow pattern, and also to investigate specific areas with a view to their geothermal energy potential. A series of several dozen geothermal gradient measurements have so far been made in abandoned boreholes and wells in El Paso, Hudspeth, Culberson, Presidio and Brewster counties; some 70% of the data collected to date comes from the Presidio Bolson, in which much of the hot spring activity is located. In general, it is apparent that gradients are higher on the downthrown side of the boundary faults, in the Rio Grande Valley, than they are on the "top" side. They are particularly high in the vicinity of some of the springs (several being over 100°C/km). Figure 2 is a plot of bottom-hole temperatures versus depth in these boreholes. The points are distinguished as those occurring above (i.e. east of) the boundary faults and those below (in the Rio

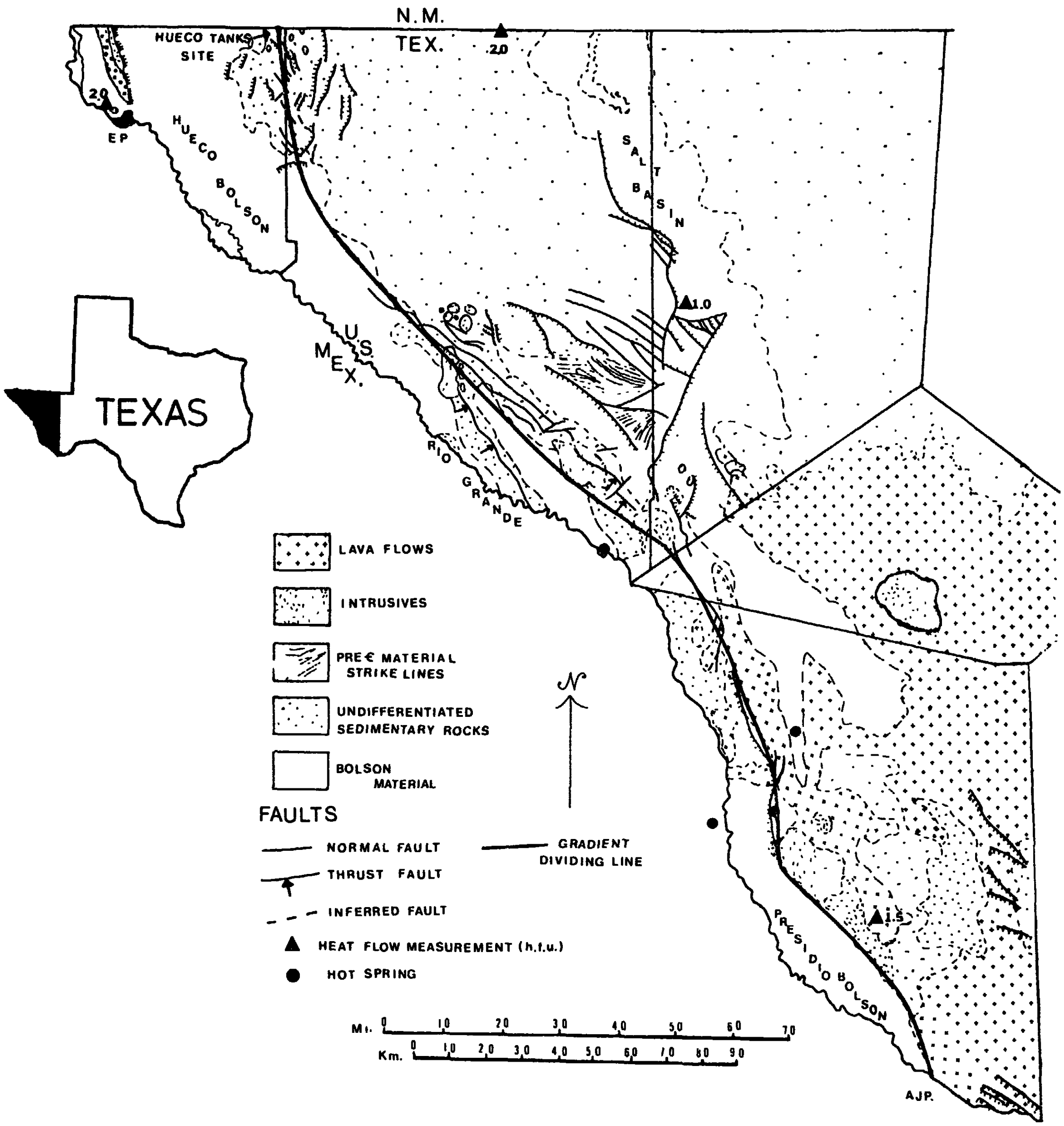

Figure 1. Tectonic map of Trans-Pecos Texas. Hot springs and published heat-flows are also shown. See text for an explanation of the gradient line.

Grande Valley). Although somewhat scattered, the two sets of points remain separately zoned; least-squares lines through them give gradients of 30.1 °C/km above the bolson, and 76.6 °C/km in the valley (the solid line in Figure 1 represents the boundary between these two gradients). This marked difference may reflect the previously mentioned junction between the Basin and Range and Great Plains tectonic provinces. It may later be possible to extend southwards a crustal-thinning model similar to that of Decker and Smithson (1975) into the present area of interest, to explain the high gradients.

Geochemical work by Hoffer (1979) in West Texas has delineated several thermally anomalous areas by the use of silica geothermometry. The largest of these is in the southern Presidio Bolson, in Presidio County and adjacent Chihuahua, and includes the main region of natural thermal activity. Another small anomaly occurs in nothern El Paso County, which apparently extends into New Mexico. Here, the SiO_2 geothermometer predicts source temperatures in excess of 140°C. The Hueco Tanks site, as

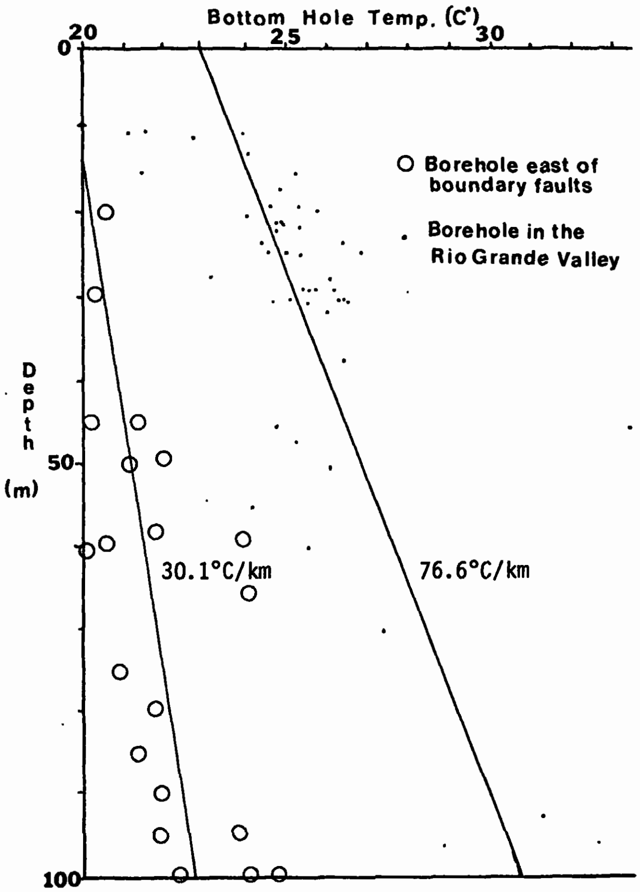

Figure 2. Gradient plot constructed using bottom-hole temperature data for boreholes in West Texas.

we have called it, is about 25 miles east of El Paso, and could thus, if proven, provide an energy resource to a city which is already rapidly expanding towards it.

Current exploration efforts are therefore directed towards an evaluation of this prospect. A series of 50m boreholes, drilled in a west-to-east line across the geochemical anomaly, has revealed high geothermal gradients, from 106°C/km in the west increasing eastwards to 289°C/km. These compare with a "normal" gradient of 42°C/km measured in an abandoned well 7 miles to the southeast. As is the case in Presidio County, Hueco Tanks is situated at the faulted eastern margin of a graben, this time the Hueco Bolson, an alluvium filled structure reaching a depth of over 2km (Davis and Leggat, 1967). Most of the boreholes are therefore in bolson-fill, but a 125m hole slightly to the south of the others has penetrated Permian limestone (a downdropped fault-block from the nearby Hueco Mountains), and the high geothermal gradient continues in this medium. Preliminary thermal conductivity measurements on the core taken from this hole yield a heat-flow of 11 h.f.u. Further work is under way to determine the subsurface structure responsible for the high surface heat-flow, and to discover the precise nature of the geothermal resource.

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