CHARACTERIZING FAVOURABLE STRUCTURAL SETTINGS OF GEOTHERMAL RESERVOIRS IN EXTENSIONAL REGIONS: ENHANCING EXPLORATION STRATEGIES

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Exploration of geothermal systems is commonly hampered by the risk of unsuccessful drilling. A major problem in selecting well sites is that the favourable settings of known systems are generally not adequately characterized. This is particularly important in amagmatic regions, where faults are the dominant control on geothermal fluids and obvious magmatic heat sources are lacking.

To better characterize the structural controls on geothermal systems in extensional settings, we have analyzed numerous fields in the relatively amagmatic Basin and Range (USA) and Aegean (western Turkey) extensional provinces. Methods include detailed geologic mapping, structural analysis, gravity surveys, and studies of surficial geothermal features (e.g., travertine, sinter, springs, fumaroles). Our findings suggest that many fields occupy a) discrete steps in normal faults; b) intersections between normal and transverse oblique-slip faults; c) overlapping oppositely dipping normal fault zones, d) terminations of major normal faults, and e) transtensional pull-aparts. These settings are typically associated with steeply dipping faults, commonly involving subvertical conduits of highly fractured rock along Quaternary fault zones oriented approximately perpendicular to the least principal stress. General topographic features indicative of these settings include: 1) steps in range-fronts, 2) interbasinal highs, 3) series of relatively low, discontinuous ridges, and 4) lateral terminations of mountain ranges. Surficial features, such as tufa towers, travertine spring mounds, and sinter deposits, are also associated with many systems. These structural, topographic, and surficial features may indicate blind geothermal systems, which have no surface thermal waters or steam.

We have successfully applied our findings to exploration of several geothermal fields in the Basin and Range province, including Desert Peak, Desert Queen, Salt Wells, and Astor Pass. Further characterization is needed, however, of favourable structural settings and other critical parameters (e.g., geophysical and geochemical signatures) to substantially reduce the risks of geothermal exploration.