frequencies lower than .3 Hz was poor. A new scheme has been devised using a remote reference natural field noise cancellation system that should lower the low-frequency cutoff by at least one decade.

Stacking and Interval Velocities in the Lower and Upper Crust by a Special Reflection Seismic Survey in the Region of the Urach Geothermal Anomaly GT-9

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The Urach geothermal anomaly in southern Germany is of special interest for the exploitation of thermal energy. Therefore, several geophysical surveys have recently been carried out in the Urach area. One of them, i.e., reflection seismics, was aimed at discovering bodies of reduced *P*-wave velocities which could infer increased temperatures.

Two lines were shot off end with 8-fold coverage and an average spread length of 23.2 km, using 3 recording units with 48 channels each. Reflections could be observed from the medium and lower crust, including, probably, the Moho. Due to the large maximum shot-geophone distance of more than 20 km, these reflections exhibit normal moveout times of about 1 sec and more. These large time values yield rather precise optimal stacking velocities which can be continuously computed along the two seismic lines. The Mesozoic and upper Paleozoic cover of between 1 and 1.5 km, however, first has to be removed from the observed times by "seismic stripping" in order to obtain meaningful results. From the stacking velocities and reflection times interval velocities can be derived as well as the surfaces separating the bodies of different velocities. In these computations, dip and curvature influences of the body boundaries are taken into account, if necessary.

Geothermal II

Two- and Three-Dimensional Magnetotelluric Modeling with Applications to Crustal Structure and Reservoir Assessment at the Roosevelt Hot Springs, KGRA, Utah GT-10

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In a previous SEG presentation by Wannamaker, some problems with 3-D conductivity inhomogeneities at the Roosevelt Hot Springs were pointed out. Distortions of both principal apparent resistivity functions (ρ_a) down to the lowest frequency of observation by polarization charge or current-gathering phenomena invalidated standard 1-D and 2-D transverse electric (TE), interpretation. However, the impedance phase (ϕ) was shown on the basis of model studies and minimum phase assumptions not to be permanently biased by such effects.

A tensor Green's function formulation has been applied to describe the low-frequency behavior of other magnetotelluric quantities for a general 3-D body in a general layered earth. This development has shown that all four impedance elements, the principal apparent resistivities, and the magnitude of the vertical admittance elements Y_{zx} and Y_{zy} will be distorted to arbitrarily low frequencies by surface charges. On the other hand, the impedance phases, the vertical transfer function elements K_{zx} and K_{zy}, the tipper, and the phases of Y_{zx} and Y_{zy} do not suffer such a permanent distortion.

The above theoretical development is supported by 3-D integral equation model results and explains many characteristics of the observed data at Roosevelt Hot Springs, e.g., inconsistencies and variations with frequency in strike estimations using Y_{zx} and Y_{zy}. The numerical studies concern other strike estimators as well, including impedance element magnitudes and phases, vertical transfer function elements K_{zx} and K_{zy}, and the tipper. Present models, while not exhaustive, indicate that tipper strike is superior in the presence of small-scale conductive noise. 3-D studies have also been aimed at the applicability of 2-D algorithms in an electrically complicated field area. Utilizing a 3-D conductive prism representing the Milford graben sediments, it is shown that apparent resistivity and impedance phase corresponding to the electric vector perpendicular to tipper strike can be modeled frequently and successfully using a 2-D transverse magnetic (TM) program.

Armed with the above insight, we have modeled profiles of ρ_a and ϕ for the E-W polarization of electric vector across and to the north of the Roosevelt Hot Springs with a 2-D TM algorithm. An excellent data fit and complex but generally well-resolved geoelectric sections have resulted. Quaternary Lake Bonneville clays ($\rho = 1.2$ Ω-m) exist to depths of 500 to 700 m and overlie great thicknesses (>1 km) of Tertiary semiconsolidated sediments ($\rho \simeq 50$ Ω-m). The average 1-D resistivity profile of the Basin and Range province, while multilayered in detail, consists crudely of 35 to 40 km of 3000 Ω-m crust below which resistivities drop rapidly to around 100 Ω-m. The brine-saturated reservoir zone, which appears to be fairly narrow and steeply dipping, is not resolved as well as desired by this polarization of electric vector. A relatively small number of soundings are apparently effected by the reservoir for this mode.

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