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Hydrogeology of a Possible Geothermal System near Deeth, Nevada

Study of a possible geothermal system near Deeth, Elko County, Nevada, included geologic mapping, hydrogeochemical analyses, and geophysical interpretation . Geologic and geophysical methods emphasized structure, particularly Paleozoic thrust faults overprinted by Miocene listric normal faulting. Hydrogeochemical analyses showed geothermal fluids to be sodium-bicarbonate water, probably of meteoric origin. The geothermal model is convection cells caused by deep circulation along the Marys River fault zone. The reservoir is fractured rock along the fault zone. Silica geothermometry predicts a reservoir temperature of 165°C (329°F).

A Paleozoic sedimentary range block is separated by the Marys River fault zone from a Tertiary basin-fill sequence to the east. Allochthonous western facies rocks at Twin Buttes were emplaced along the Roberts Mountains thrust. Eastward-thrusted upper Paleozoic units are exposed in the Peko Hills. A thick, bimodal, Oligocene-Pliocene volcanic sequence covers the area's northwest corner. The Miocene Humboldt Formation is a tuffaceous, fluviatile lacustrine basin-fill unit that onlaps the range block and thickens basinward. Quaternary hot-spring deposits are localized along the Marys River fault zone.

The Miocene-Pliocene Marys River fault zone is a north-trending, down-to-the-east, normal fault system. A shear zone may be present where the fault zone undergoes right separation. Hydrogeochemical, thermal water, and heat-flow anomalies are localized along the fault zone.

The proposed model calls for deep circulation of meteoric water along the Marys River fault zone. Surface water from the Marys River percolates down the fault and is heated to approximately 165°C (329°F). Thermal water migrates laterally, then rises back up the fault. Upwelling thermal water creates the three observed thermal anomalies. Leakage of geothermal fluid into discontinuous sand and gravel channels of the Humboldt Formation gives rise to broad, low-temperature anomalies. The high-temperature reservoir is fractured rock along the Marys River fault zone.

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Professionalism, Ethics, and the Petroleum Geologist

No abstract.

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Some Broader Aspects of Professionalism

No abstract.

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Late Paleogene Abyssal Circulation in North Atlantic

The earliest phase of intense abyssal circulation in the North Atlantic occurred near the Eocene-Oligocene boundary about 36 to 38 Ma. The abyssal currents eroded a prominent unconformity that is best developed along and near basin margins and at paleodepths below about 3 km (9,800 ft). The unconformity forms a strong reflecting interface in both the northern North Atlantic (reflector R4) and the western North Atlantic (horizon A^u). We estimate from the geometric relations of the unconformity that about 0.5×10^6 km^3 of sediment were eroded from the margins of the northern and western North Atlantic basins. Below the unconformity, bedding relations in seismic reflection profiles show little evidence for significant abyssal circulation; however, deep-sea boreholes have recovered abundant biosiliceous Eocene sediments that may be related to increased upwelling that was stimulated by a weaker, precursory abyssal circulation phase.

Erosional and depositional patterns indicate that the bottom water source for the early Oligocene abyssal circulation system was in the northern Atlantic. The Greenland Sea opened about this time and may have provided a passage for dense, intermediate or deep Arctic water to enter first the Norwegian Sea and then the North Atlantic via passages in the Greenland-Scotland Ridge (Denmark Straits and Faeroe-Shetland Channel). This water presumably penetrated into the South Atlantic and beyond, transporting its suspended sediment load to depositional locales peripheral to and away from basins margins. Penetration of the water mass to circum-Antarctic areas may have provided a reinforcing teleconnection that aided formation of deep and bottom water around Antarctica, which apparently was prerequisite to initial development of the global psycrosphere at this time.

There is a suggestion in the distribution of the unconformity in North Atlantic borehole and seismic data that with time the abyssal currents progressively affected shallower sea floor (< 3 km; < 9,800 ft) and became more restricted to proximal areas of basin margins. Along the eastern United States continental slope and probably elsewhere, the unconformity locally was reexcavated by erosion (turbidity currents and sediment mass movements) associated with a mid-Oligocene sea-level lowstand. Flow intensity of the abyssal current system decreased throughout the Oligocene. By late Oligocene to early Miocene time, current-controlled deposition, as opposed to erosion and/or transport, was widespread. Most of the major sedimentary ridges first began to nucleate at this time and sediment waves became a common and persistent feature in the sedimentary record.

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Synthetic Cyclic Stratigraphy

There are many examples of cyclic stratigraphy in the sedimentary record. Cyclothems have amplitudes of a few tens of meters. They are often attributed to sea level changes caused by glaciations. Assuming modern glaciations to be applicable, the expected period τ would be about 10^5 years and sea level would be expected to rise rapidly by about 100 m and then to fall slowly. We have modeled this cycle by an instantaneous rise in sea level (h) following by a linear fall. In order to generate cyclic stratigraphy, this cyclic sea level change must be superimposed either on a long-term sea level increase or upon tectonic subsidence; we model either with a constant velocity u_o. The thickness of each sedimentary cycle is $u_o\tau$. We also consider constant velocity limits on the rates of sedimentation u_s and erosion rate u_e. We have determined the age-depth relations in sedimentary cycles, the lengths of hiatuses, and the water depths as functions of the nondimensional parameters $h/u_o\tau$, u_s/u_o, and u_e/u_o. By specifying horizontal variations of the nondimensional parameters, we have generated synthetic seismic stratigraphy. This stratigraphy is characterized by toplap and pinch-out. Observed seismic stratigraphy has been interpreted in terms of cyclic sea level changes