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Salinity Structure of the National Petroleum Reserve, Alaska: Implications for Pathways of Regional Fluid Flow

The area of the Coville foreland basin within the National Petroleum Reserve, Alaska (NPRA) has been termed the largest remaining frontier region for hydrocarbon exploration in North America, and understanding potential pathways for fluid flow within the basin is thus important. Records and wireline logs for over 30 wells drilled in the NPRA provide information that can be used to constrain interpretation of regional flow of basinal waters to depths of over 4 km. Hydraulic heads estimated from mud weights show that groundwater flow occurs generally from south to north, but with divergence to the northeast and northwest away from the Meade Ridge. Salinities calculated from SP logs range from less than 1 g/L, to marine values of 35 g/L, to hypersaline values of over 150 g/L. The entire sedimentary section to a depth of 2 km or more has been preferentially permeated with meteoric water east of the Meade Ridge in an area corresponding to the sandiest portion of the Nanunshuk Group. Much of the western portion of the NPRA has retained a marine signature. Low salinity waters along the coast likely represent areas of groundwater discharge. These may be fed by deep (> 4 km), more highly permeable sections of Ellesmerian sediments. Deep, hypersaline waters occur along the eastern margin of the NPRA and in fault slices in the Brooks Range and have survived meteoric flushing. The brines were probably formed at the time of deposition of the Lisburne carbonates.