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Petroleum Exploration History and Subsurface Geology of the Castle Mountain Fault Anticline Near Houston, South-Central Alaska

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ABSTRACT

The Castle Mountain fault anticline is located on the north side of the seismogenic Castle Mountain fault near Houston, about 30 miles north of Anchorage. Previous work, including a published seismic-reflection profile, showed that the anticline is cored by several steeply-dipping faults and that the crest of the anticline is coincident with an aeromagnetic high that parallels the surface trace of the Castle Mountain fault. Here we provide a short history of petroleum exploration on the anticline and report new isotopic and biostratigraphic results that yield further insights into its subsurface stratigraphy and structure. Coal was discovered near the crest of the anticline in Houston in 1917 during excavation for a cut along the Alaska Railroad. A mine was established and produced subbituminous coal from the Tyonek Formation, which yielded plant fossils of the Seldovian floristic stage indicating an age of early to middle Miocene. During 1951-1952, the U.S. Bureau of Mines drilled three core holes to subsea depths of -137 to -812 feet near Houston and found sandstone intervals in the Tyonek Formation that flowed methane gas and brackish water. During 1954-1963, five wells named for Rosetta, wife of one of the operators, were drilled as oil and gas exploration wells to subsea depths of -887 to -5,774 feet. All five Rosetta wells were dry holes with confirmed shows of gas and unconfirmed reports of minor oil stains. During 1998-2004, four wells were drilled on the anticline in search of coalbed methane. No commercial production was established but the Houston 3 well reportedly flowed gas at 2-3 mcf/day from perforations in five coal beds in the Tyonek Formation at subsea depths of -1,027 to -1,545 feet. The Houston Pit 1 well, drilled in 2004 as a coalbed methane test near the crest of the anticline, spudded in the Tyonek Formation. At a subsea depth of -1,042 feet, this well found the top of the Arkose Ridge Formation, consisting of nonmarine conglomerate, sandstone, and basalt. Two core samples of basalt from depths of -1,247 and -1,279.5 feet yielded whole-rock [sup]40[/sup]Ar/[sup]39[/sup]Ar ages of 58.6Â±1.6 Ma and 58.8Â±2.4 Ma, respectively, indicating a late Paleocene age for these rocks. We hypothesize that basalt in the Arkose Ridge Formation may be the source of the aeromagnetic high associated with the Castle Mountain fault anticline. The Rosetta 3 well spudded in the Tyonek Formation on the south flank of the Castle Mountain fault anticline and found the top of the Arkose Ridge Formation at a subsea depth of -1,655 feet. At -2,165 feet the well apparently penetrated a fault and entered an interval of sandstone, siltstone, shale, and coal that persists to the total depth of the well at -5,774 feet. Core samples from this interval contain fossil leaf impressions and a freshwater clam, and palynomorphs indicate a probable Miocene age and terrestrial depositional setting. These results suggest that the interval from -2,165 to -5,774 feet is correlative with the Tyonek Formation. If this interpretation is correct, then there is likely an unnamed contractional fault at -2,165 feet in the Rosetta 3 well that places Paleocene Arkose Ridge Formation above Miocene Tyonek Formation. The geometry of this unnamed

fault is unclear; it may be a north-dipping synthetic reverse fault that parallels the Castle Mountain fault, or it may connect at depth with the surface trace of the Castle Mountain fault in a positive flower structure.