

Palynomorph Age and Thermal Alteration of the Mississippian Manning Canyon Shale and Doughnut Formation- Implications for Paleozoic Shale-Gas Potential of Western and Central Utah

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The Mississippian Manning Canyon Shale and Doughnut Formation are shallow- to restricted-marine, organic-rich shale with minor limestone and quartzite. The Doughnut is a new shale-gas play in central Utah; the Manning Canyon potential in western Utah has not been explored. Geologists often refer to both formations as Manning Canyon, but significant differences exist. We restrict the Manning Canyon to the allochthonous rocks of the eastern Basin and Range Province and central Utah thrust belt, and the Doughnut Formation to the autochthonous rocks of central and eastern Utah.

The formations are typically poorly exposed, prone to land sliding, and offer only a few glimpses into the nature of the strata. We analyzed palynomorphs extracted from samples of the limited outcrops and from well cuttings to compare the age of the two formations. The thermal alteration (R_o equivalent) of the palynomorphs was determined and combined with published data to map changes in the thermal maximum throughout the region.

The Manning Canyon Shale, more than 1000 feet thick, is middle to late Chesterian (possibly as young as Morrowan), and samples have a R_o equivalent of 1.5-3.0, beyond peak gas generation except for the easternmost outcrops. The Doughnut Formation, generally a few hundred feet thick, is late Meramecian through late Chesterian, equivalent to the Manning Canyon and underlying Great Blue Limestone in the Basin and Range Province. The Doughnut samples generally have an R_o equivalent of 0.7-0.8, within the oil generation window. There are no penetrations of the Doughnut in the deep Uinta Basin where the formation is at maximum burial.

Preliminary burial histories show both formations reached maximum burial depths of 24,000-40,000 feet during or shortly after the Late Cretaceous Sevier orogeny, but the Manning Canyon Shale reached peak gas generation much earlier than the Doughnut Formation. Disruption of seals during Basin and Range extension may have resulted in the loss of most of the gas in the Manning Canyon, but shale-gas potential may exist in the eastern basins if sufficient kerogen was preserved for a second phase of gas generation after extension. Recent drilling in central Utah has demonstrated the shale-gas potential of the Doughnut but the extent of the play is poorly defined.