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Stratigraphic Characterization of the Birds Nest Aquifer in the Uinta Basin, Utah: Updated Research Regarding the Aquifer's Potential as a Significant Saline Water Disposal Zone

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During deposition of the upper Green River Formation in the late Eocene, Utah's Lake Uinta transitioned from a balanced-filled basin dominated by organic-rich, laminated marlstone, to an underfilled restricted basin. During this time, the saline mineral nahcolite formed within the deep-lake sediments (depocenter in central Uintah County) as isolated crystals, nodules ranging up to one foot in diameter, and beds ranging from less than an inch to 2 feet thick. Post-deposition, the saline mineral shortite was deposited in fracture zones several feet thick. More recently, the Birds Nest aquifer formed from the dissolution of these saline minerals and is targeted by natural gas producers as a potential saline water disposal zone.

Recently completed core descriptions, measured sections, and five newly constructed stratigraphic cross-sections show that the total thickness of the saline zone ranges from <100 feet on the basin's eastern and southern margins to >300 feet in the basin's depocenter. Only in the basin's depocenter, where the Birds Nest aquifer comprises two or three stratigraphic zones of dissolution each roughly 40 feet thick, is there potential for extensive saline water disposal. Ongoing research and monitoring programs seek to determine if these individual zones are hydraulically connected or if the Birds Nest as a whole is vertically connected via fractures/joints (possibly gilsonite veins) to other water-bearing zones both above and below.

Regional water sampling shows that the Birds Nest's water chemistry in the north (averaging >10,000 ppm TDS and as high as 100,000 ppm TDS) is distinct from that in the south (averaging <10,000 ppm TDS and as low as about 1000 ppm TDS). This abrupt change in water chemistry is most likely due to the differing amounts of saline mineral dissolution in the two areas; the southern area may have been flushed clean, whereas saline minerals in the northern area are still actively dissolving. The presence of intact nahcolite in the Utah State 1 core (section 26, T. 9 S., R. 21 E.) – on display with this poster – demonstrates that there are still zones of no dissolution north of the 10,000 ppm TDS line. Just to the south of this well, the saline minerals in the Birds Nest show significant dissolution, as seen in the Utah State 13X-2 core (section 2, T. 10 S., R. 21 E.) – also on display. Separating these two areas is a prominent gilsonite vein that cross-cuts the Birds Nest aquifer. The northwest-trending gilsonite veins in the area seem to influence groundwater flow patterns in the Birds Nest by creating "channels" of dissolution and impermeable barriers to flow.

The Birds Nest aquifer's spatial and stratigraphic extent and variability, water chemistry, and zones of differential dissolution will determine possible saline water disposal volumes and safe disposal practices, both of which could directly affect the success of increased petroleum production and potential oil shale development in the region.