

## **Undiscovered Oil and Gas Resources in the Mission Canyon and Charles Formations, Williston Basin, North Dakota and Montana**

Gaswirth, Stephanie B.<sup>1</sup>; Lillis, Paul G.<sup>1</sup>; Roberts, Laura N.<sup>1</sup>; Anna, Lawrence O.<sup>1</sup> (1) U.S. Geological Survey, Denver, CO.

The U.S. Geological Survey (USGS) completed an assessment of the technically recoverable undiscovered oil and gas resources of the U.S. portion of the Williston Basin in 2008. The assessment is based on geologic elements and processes within a petroleum system, which include detailed stratigraphic and structural framework studies and petroleum-system modeling, and on historical exploration data and production analyses that are applicable to resource estimation. Using this approach, the USGS defined ten total petroleum systems (TPS) in the Williston Basin that included thirteen conventional assessment units (AU) and six continuous (unconventional) AUs. Two of the TPSs contain Mississippian Madison Group strata: (1) the Bakken-Lodgepole TPS, which includes the Lodgepole Formation; and (2) the Madison TPS, which includes the Mission Canyon and Charles Formations. The Mission Canyon and Charles Formations, containing the youngest carbonate reservoirs, are the largest producers of oil to date (>1 BBO).

The Madison TPS is defined as the area where Madison Group oils have accumulated in the Mission Canyon and Charles reservoirs, as well as in reservoirs of the Triassic Spearfish Formation. The TPS is defined on its eastern limit by the Tilston interval subcrop and the southeastern boundary is defined by the extent of the mapped anhydrite beds of the Mission Canyon and Charles Formations. The TPS boundary follows the outline of the Cedar Creek Composite AU to the southwest, the Williston Basin province boundary to the west, and the U.S.-Canadian border to the north.

One continuous reservoir assessment unit, the Mission Canyon-Charles AU, was defined within the Madison TPS and its boundaries coincide with the TPS boundaries. There is extensive production throughout the AU on major structures and in stratigraphic combination traps. The largest fields are on the Little Knife, Billings Nose, and Nesson Anticlines. Recent studies emphasize that Madison Group oils are self-sourced by Mission Canyon and Ratcliffe interval organic-rich carbonates that are adjacent to reservoirs. Traps are stratigraphic, structural, and diagenetic, and seals are formed by overlying or lateral evaporites or tight carbonates. Based on available geologic and production data, the undiscovered oil resources for conventional reservoirs in the Mission Canyon-Charles AU were estimated to have a mean of 45 MMBO.