

Burrow-Mottled Carbonates in the Devonian Wabamun Formation, Pine Creek Gas Field, Alberta, Canada

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ABSTRACT

In this study area, the Devonian (Famennian) Wabamun Group consists of a series of stacked cyclical shallow water ramp carbonates that were deposited during a regressive cycle. In the Pine Creek Field (Township 56-58, Range 19-20 W5), hydrocarbons are produced mainly from the Normandville Member of the Wabamun Group (cumulative gas production 455 Bcf). The Normandville Member consists of cyclical mudstones, intraclast wackestones, and peloidal grainstones. They were deposited on an expansive, open ramp and are characterized by extensive bioturbation, scarce shelly fossils, and by pervasive presence of peloids and intraclasts. The dolomitized peloidal grainstone zones are found at different stratigraphic levels within the ramp and constitute the major reservoirs in this play. Relationships between the biogenically-mediated substrate and porosity enhancement particularly within the Normandville Member suggest paleobiological controls on the reservoir development. Preferential dissolution and precipitation of dolomite occurs within and adjacent to burrow fabrics. The local diagenetic heterogeneities suggest a paleobiological control on succeeding dolomitization patterns. Fluid flow through burrow-mottled carbonates is notably tortuous and is similar to that seen in fractured reservoirs. These strata act as dual permeability systems (high permeability within the burrow networks and low permeability in surrounding matrix). An understanding of burrow fabrics, and paleobiological influenced dolomites and their distribution patterns provide a useful tool to exploitation and improve reservoir characterization accuracy. In the Normandville Member the ichnofossils constitute the reservoir and the understanding of anisotropic permeability trends is of fundamental importance to the successful exploitation of this and similar carbonate reservoirs.

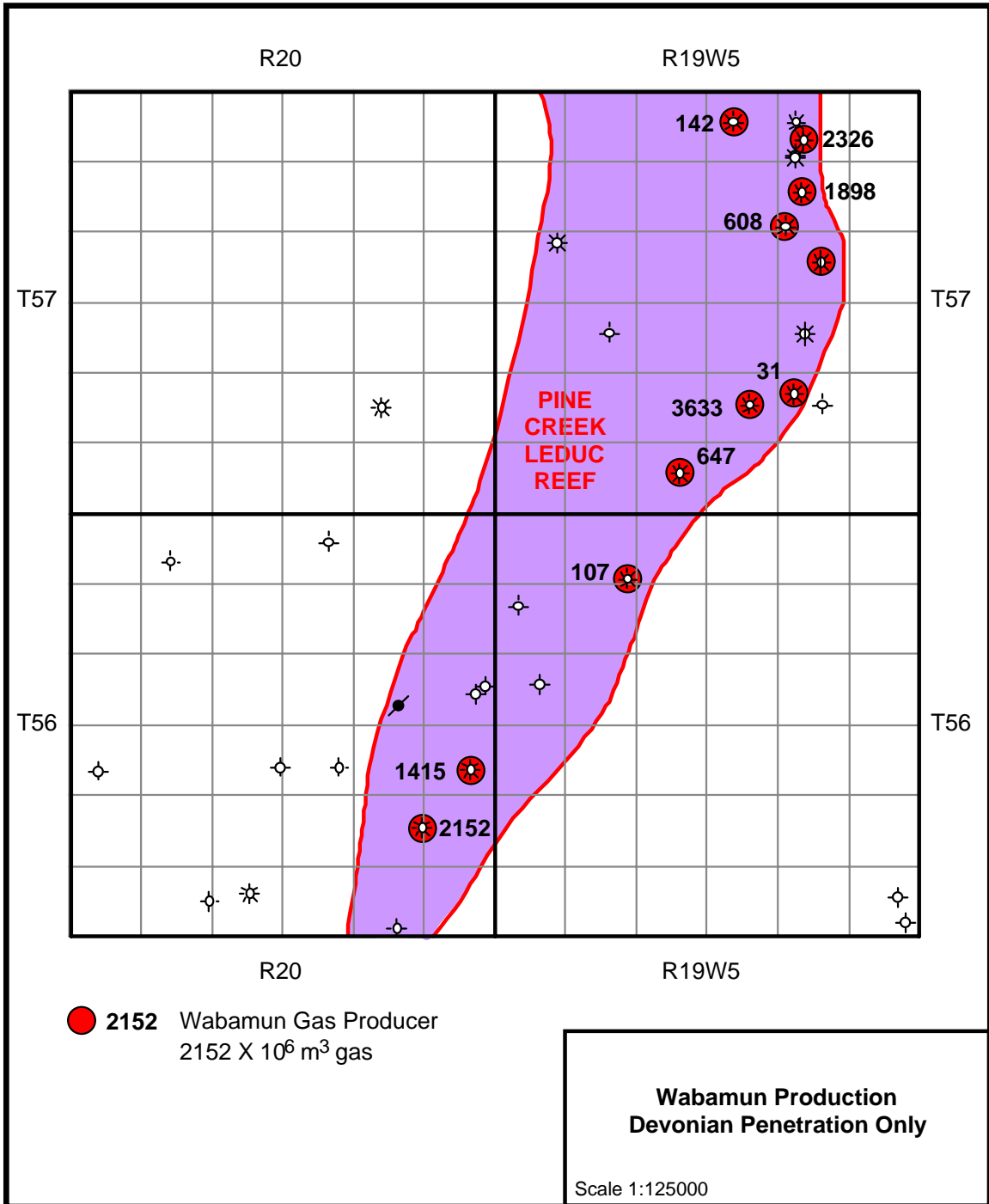


Figure 1. Map of the Pine Creek Leduc Reef and overlying Wabamun gas production.

Plate 1. Photographs of the core from the Normandville Formation of the Wabamun Group in the Pine Creek Gas Field. A) Limestone, bedded peloidal grainstone, abundant early calcite cement. Not analysed, tight. 10-11-57-19W5, 10470 ft. B) Limestone, intraclast wackestone to packstone. Early cementation of the original mudstone results in the formation of nodules. These nodules get broken up and form intraclasts. Not analysed, tight. 10-19-56-19W5, 11408 ft. C) Limestone, slightly dolomitized, scattered very fine crystalline dolomite rhombs, stromatoporoid floatstone, wackestone matrix. Not analysed, tight. 10-19-56-19W5, 11416 ft. D) Calcareous dolostone, burrowed mudstone, well-defined burrows, dolomitization along burrows. Note the large burrow in the centre of the photograph. Not analysed, tight. 10-19-56-19W5, 11393 ft. E) Dolomitic limestone, dolomitization follows microbial laminations. Plug #6, 0.8%, 1.50 mD. 11-26-57-19W5, 9848 ft. F) Dolomitic limestone, distinct burrows with associated dolomitization. Burrows (3-4 mm) filled with dark grey, very fine crystalline dolomite surrounded by a halo of light grey, very fine crystalline dolomite. Not analysed, tight. 10-34-56-20W5, 11017 ft.

PLATE 1

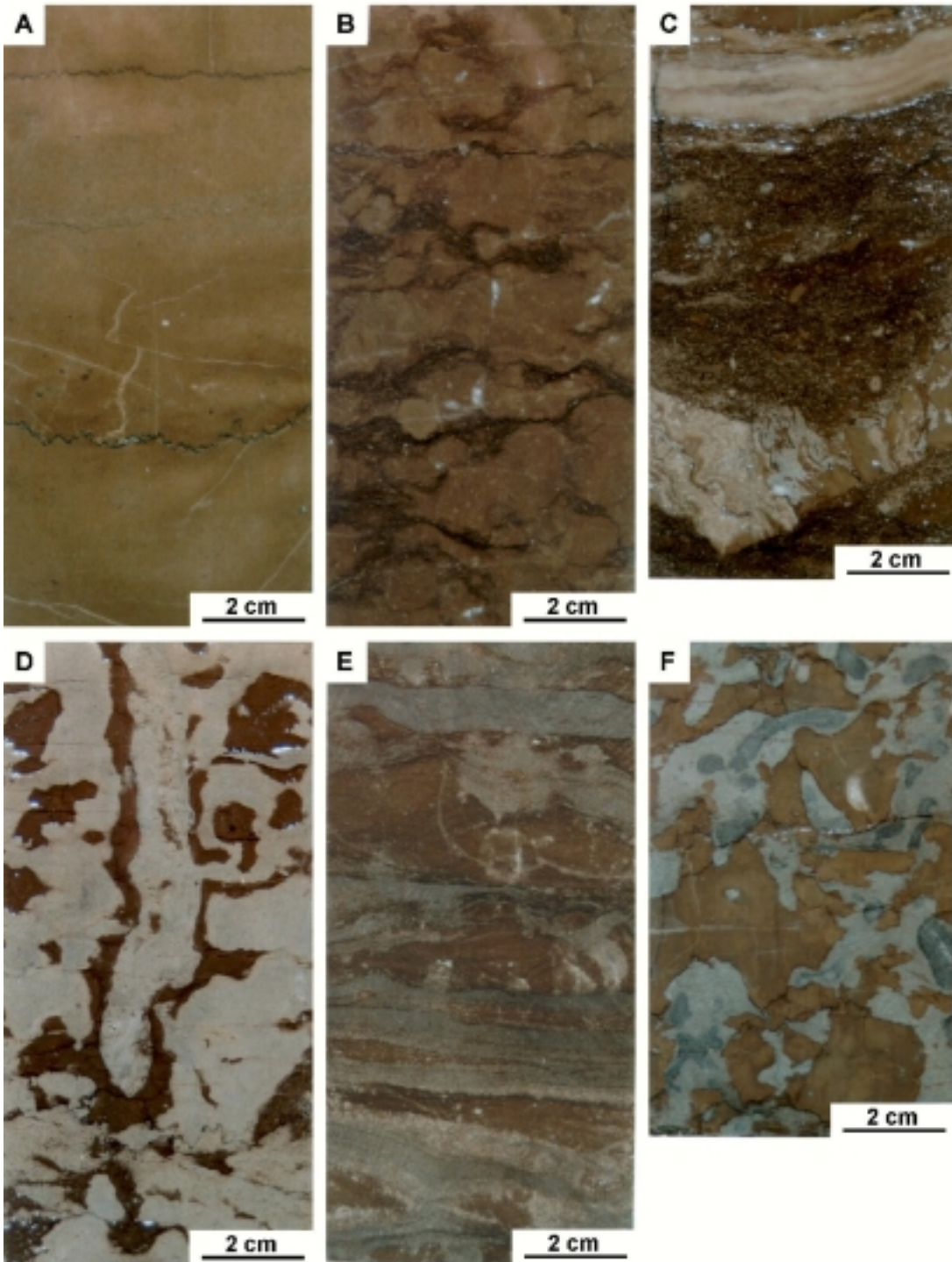


PLATE 2

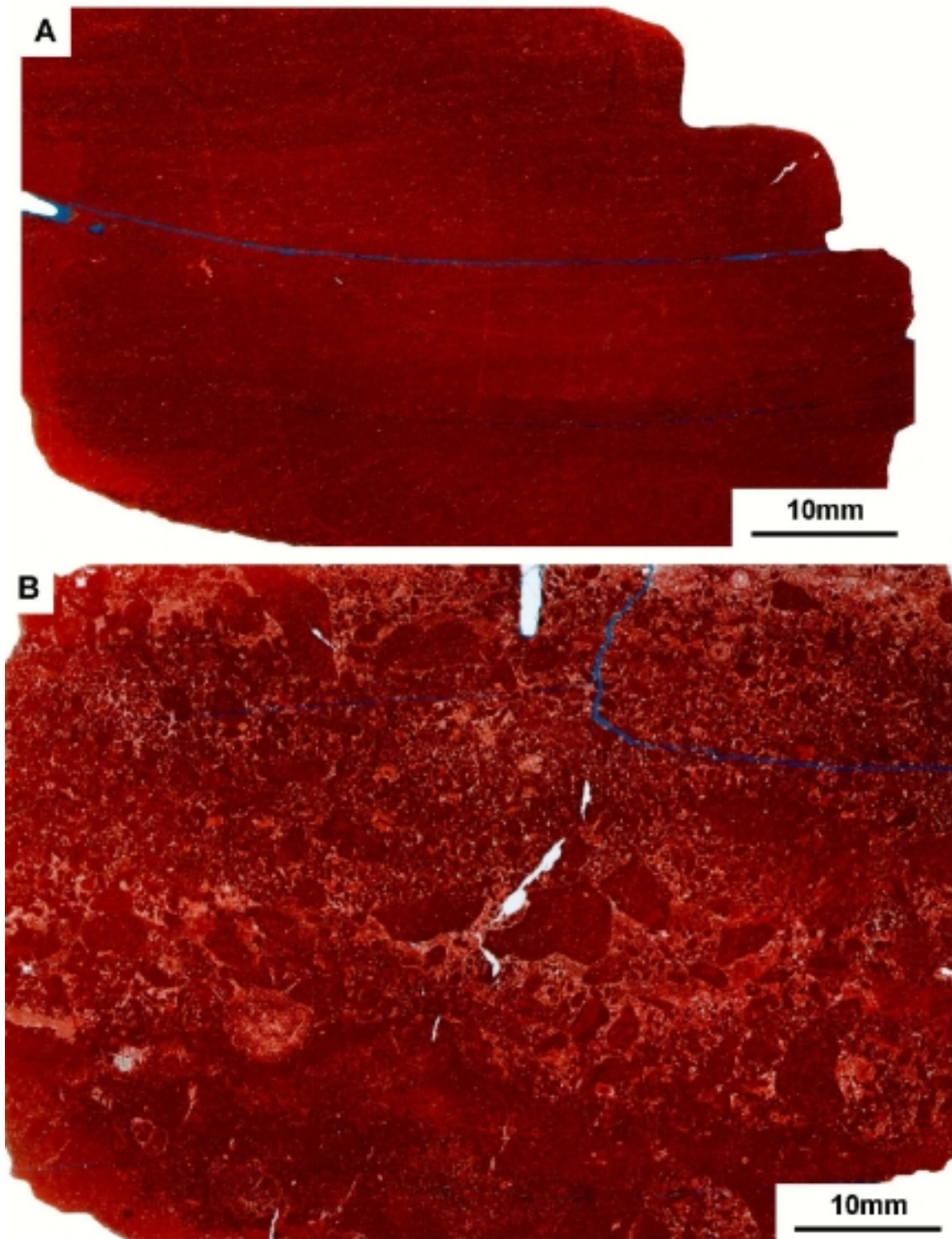


Plate 2. Thin section photomicrographs. A) Organic rich mudstone. B) Coarse-grained intraclast floatstone with isolated gastropods, crinoid fragments, and sponge spicules.

PLATE 3

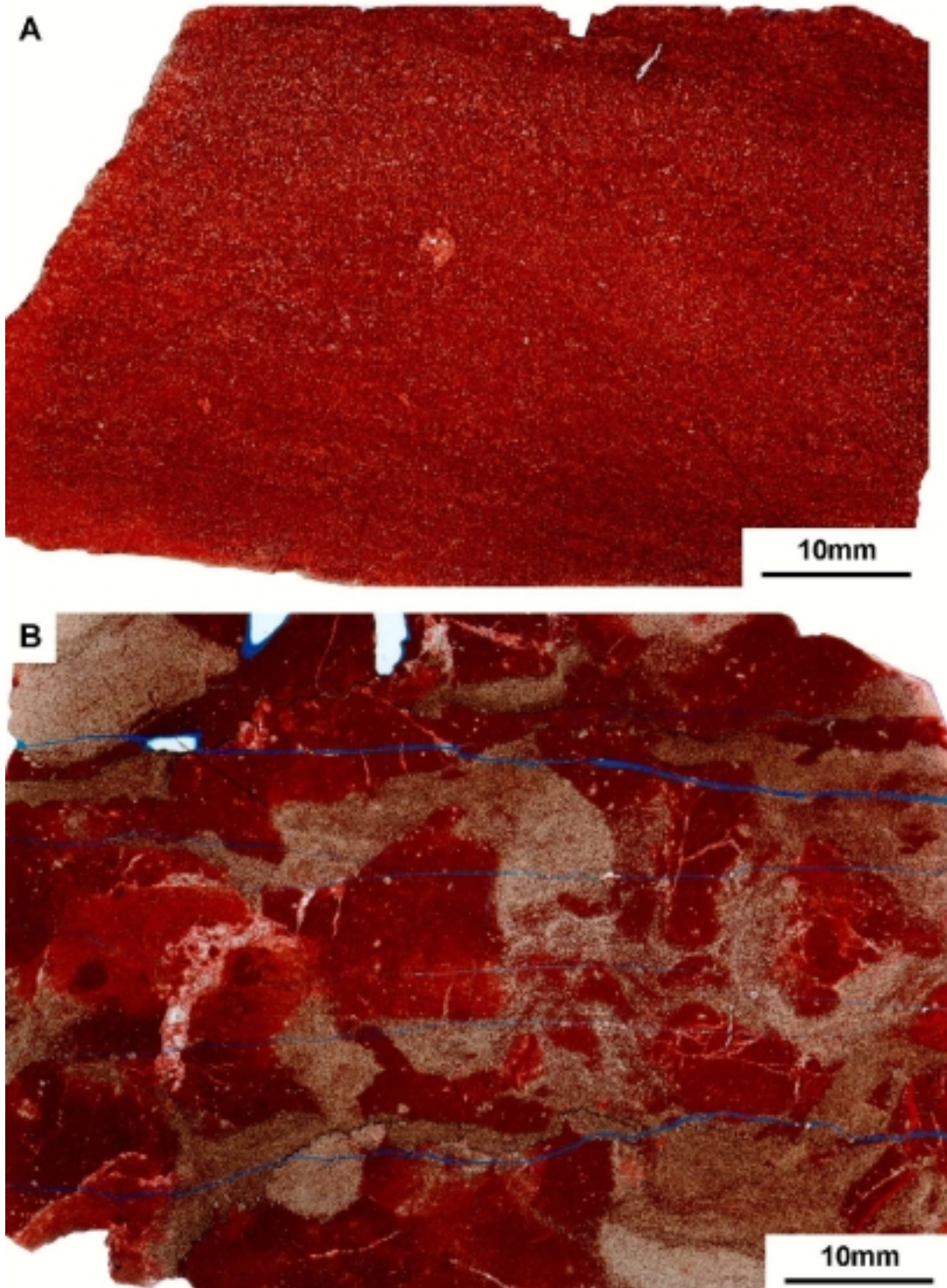


Plate 3. Thin section photomicrographs. A) Very fine-grained peloidal grainstone with abundant early calcite cement. B) Dolomitic limestone, wackestone, dolomitization follows burrows.