Paleomagnetic Orientation of Fractures in Jean Marie Member Cores from NE British Columbia/NW Alberta

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ABSTRACT

The Jean Marie Member of the Redknife Formation is a regionally widespread Upper Devonian carbonate with estimated OGIP of 35,671 10^6 m^3. Low matrix permeability within the Jean Marie means that fracturing due to regional tectonism and compactional drape may provide the key to good well deliverability.

The Jean Marie may be a good candidate for horizontal drilling, where the goal is generally to intersect the maximum number of open natural fractures. The optimum trajectory for a horizontal well depends on the angular relationship between the paleostress field (represented by natural fractures) and the modern in situ stress field (represented by drilling- and coring-induced fractures). Natural fractures most closely aligned with present-day maximum horizontal stress are more likely to be open in the subsurface and to remain open during production.

Paleomagnetic orientation of fractures in existing cores has proven to be a reliable, accurate method for determining paleostress and in situ stress prior to drilling. Our paleomagnetic analyses of Jean Marie cores from 4 different wells reveal that mineralized natural fractures strike 15° clockwise of induced fractures and that induced fractures strike ENE, consistent with published wellbore breakouts from this region.

In other projects, tests against FMI/FMS confirm the accuracy of our paleomagnetic technique, which works equally well on fresh cores and on cores drilled decades ago. Paleomagnetic orientation of fractures in cores stored in the large repositories in Calgary and Fort St. John is a wise investment when planning optimum trajectories for horizontal and deviated wells in fractured reservoirs.

INTRODUCTION

Within the last few years, the Jean Marie has emerged as a new and exciting target for horizontal drilling. It has been estimated[1] that only 33 percent of the gas resource in the Jean Marie had been discovered by 1993, leaving 24,035 10^6 m^3 (849 Bcf) OGIP undiscovered. Of the estimated 282 pools yet to be discovered, about 18 are predicted to have OGIP > 283 10^6 m^3 (10 Bcf), and some could be as high as 2,158 10^6 m^3 (76 Bcf).

The low reservoir quality of the matrix, combined with the reduced probability of encountering vertical fractures in vertical wells, makes horizontal drilling the preferred method for both exploring and developing the Jean Marie. Of critical importance in "fracture hunting" using horizontal wells, is the orientation of the well path. Since water production is not a