

IMPACT STRUCTURES IN THE WILLISTON BASIN. R.A.F. Grieve¹, K. Kreis², A.M. Therriault¹, and P.B. Robertson¹, ¹Geological Survey of Canada, Ottawa, Canada, ATherria@NRCan.gc.ca. ²Saskatchewan Energy and Minerals, Regina, Canada.

Three “new” buried impact structures have been identified in the Williston Basin in Canada. The Elbow structure (106°45'W; 50°58'N) is 8 km in diameter, circular in plan, with a ring depression and an uplifted core of fractured and brecciated target rocks [1]. The structural form is that of a complex impact structure. It has been drilled for hydrocarbons although there is no current production. Originally, the Elbow structure was thought to result from salt tectonics [2] or cryptovolcanism [1]. Sampling of drill hole material indicates the presence of quartz grains with decorated planar deformation features (PDFs; Fig. 1a).

The Maple Creek structure (109°20'W; 49°51'N) is barely visible at the surface, where repeated sections of the Upper Cretaceous Bearpaw Formation are very poorly exposed. A structural anomaly was noticed by Whitaker [4] and subsequent Vibroseis seismic profiles indicated structural disturbance to ~ 1 km depth and a slightly elliptical zone ~ 6 km in diameter with an annular trough and a central core ~ 2 km in diameter. Drilling indicates structural complexity in the core, with brecciation and repetition of beds [5]. Interpretation of seismic data suggests a structural uplift of ~ 500 m. A number of possible origins had been suggested, including impact, but all were considered equivocal [5]. Although the bulk of the lithologies in the central uplift are shales, there are a few sandy lenses in the Upper Cretaceous Lea Park Formation with rare quartz displaying decorated PDFs (Fig. 1b).

The Viewfield structure (103°04'W; 49°35'N) is considered to be a 2.4 km simple crater formed in Jura-Triassic time (~ 200 Ma), based on geophysical and drill hole data [6]. Target rocks consist of Mississippian strata, of which at least 200 m are missing in the center of the structure and replaced by young Watrous Red Beds (WRB). In the rim, Mississippian carbonates are found sandwiched between Lower WRB. There are 50 producing hydrocarbon wells, with estimated primary reserves of 10.5 MMBO and 4.5 BCFG [7]. An impact origin for the structure was suggested by Sawatzky [6]. Detrital quartz grains in the WRB display decorated PDFs (Fig. 1c). The specific nature of these grains and their very limited occurrence in materials overlying and filling the crater suggest they were washed into the Lower WRB.

These three “new” structures bring to five the number of known impact structures in the Williston Basin. Three (Newporte, Red Wing, and Viewfield) are hydrocarbon producers. Another possible impact structure (Heidt, North Dakota) is a producer, as is the 25 km diameter Steen River structure, Alberta [7]. Impact structures in this area of North America are important targets for hydrocarbon exploration. The early identification of their impact origin bears on exploration strategies.

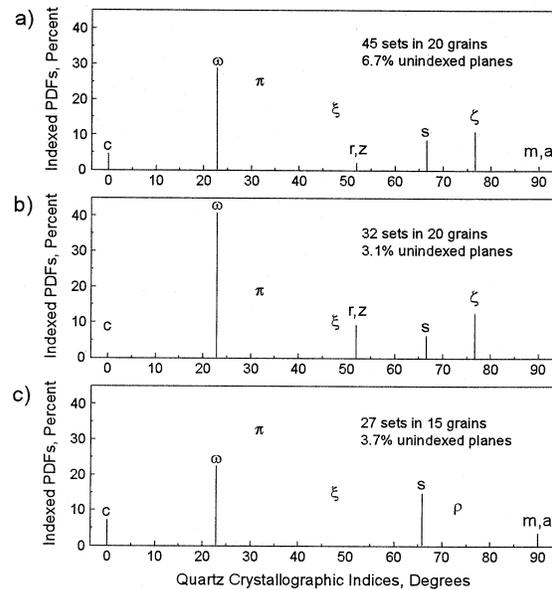


Fig. 1. Frequency of indexed PDFs in quartz from (a) Elbow, (b) Maple Creek, and (c) Viewfield. Standard U-stage and indexing techniques were used.

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