**The origin of the breccias in the lower Onaping Formation, Sudbury Structure (Canada): Evidence from petrographic observations and Sr-Nd isotope data.** Brockmeyer, P. and Deutsch, A. Institut für Planetologie, Wilhelm- Klemm-Str. 10, D-4400 Münster, F.R.G.

The elliptical *Sudbury Structure* is a unique geological feature (1) which is discussed controversially either as ancient impact suite (2) or as an endogenic "volcanic" structure (3,4). The basin-shaped structure situated on the contact between Archean rocks of the Superior Province to the north and the Early Proterozoic Huronian Supergroup of the Southern Province to the south is characterized by:
1) Brecciated and shock-metamorphosed basement rocks of the "footwall" (5); 2) The 1.85 Ga old (6) Sudbury Igneous Complex; and 3) various breccias and sediments of the Whitewater Group which fill the Sudbury basin (Fig. 1). The lowermost part of the Whitewater Group is the *Onaping Formation* consisting of 1500 m of different allochthonous polymict breccia layers. These enigmatic breccias are key rocks for the understanding of the origin of the Sudbury Structure. Based on detailed mapping in the northern part of the Onaping Formation near Levack and petrographical studies we divide the lower part of the formation into two different breccia units, the *Basal Member* and the *Gray Member*.

The Basal Member is a breccia very rich in lithic clasts with a crystalline matrix with the main constituents plagioclase and altered pyroxene. The observed granophyric, intersertal and quench textures give a clear hint for crystallization from a melt. The contact between this *crystalline melt breccia* and the overlying Gray Member is sharp and the Gray Member show features of contact-metamorphic overprint. The contact to the underlying granophyre of the Sudbury Igneous Complex, however, is gradational and especially in the lower part of the crystalline melt breccia, granophyric matrix textures identical to those from the undoubted silicate melt are common. The lithic clasts in the crystalline melt breccia are mainly metasediments originating from the Huronian Supergroup which therefore must have covered that area at the time of the impact event. All fragments in the crystalline melt breccia are thermally affected by the melt; in a few cases the have approached the melting temperature. As the matrix of the so called "Melt Bodies" (7) is petrographically identical to the matrix of the re-defined Basal Member and both share a common origin we propose to delete the term "Melt Bodies".

The Gray Member of the Onaping Formation consits of breccias with clastic matrix with a minor amount a lithic clasts, but the main constituent are irregularly shaped recrystallized fragments with a fine banded internal structure. Those are clearly equivalents to cogenetic melt particles as known from the Ries crater in Germany (8). Many of the rock and mineral fragments display shock-metamorphic features. Because of these unique characteristics the breccias of the Gray Member should be classified as *"suevite", a clastic matrix breccia with melt particles* (9).

For supporting this new interpretation of the Basal Member and the Gray Member a combined Sr-Nd study on small pieces of recrystallized glass fragments from the Gray Member and on matrix samples of the crystalline melt breccia was performed. One of the samples are from a so-called "Melt Body" (7). All samples are carefully hand-picked in order to avoid remnants of lithic and mineral clasts. Based on analyses of different splits from one crystalline melt breccia sample, it is obvious that the matrix of the crystalline melt breccia is rather homogeneous with respect to Rb, Sr, Sm and Nd concentrations on a small scale. The observed variation in $^{87}Rb/^{86}Sr$ ratios of the matrix samples point either to an inhomogeneous source for the crystalline melt breccia matrix, or our preferred interpretation, to an open Sr isotope system due to remobilization during a regional metamorphic event. This phase is recorded in the Whitewater Group by a reopening of the Rb-Sr system around 1.7 to 1.4 Ga ago (10) and was also found in the Footwall Breccia of the North Range (11). The neodymium isotope data show only little variation in both, the crystalline melt breccia matrix and the recrystallized glass fragments. In an $\varepsilon_{Sr}^{1.85\,Ga}$ - $\varepsilon_{Nd}^{1.85\,Ga}$ diagramm (Fig. 2) the analyzed melt matrix cluster with one exception on the data array published for the rocks of the Sudbury Igneous Complex (12,13,14).

**Conclusions**: 1) A genetic connection between the Footwall Breccia and the crystalline melt breccia of the Onaping Formation as proposed by (5) is not supported by the isotope data.
2) Neither the Archean basement rocks exposed to the north of the structure (large negative $\varepsilon_{Nd}^{1.85\,Ga}$ values (14)) nor granitic rocks from the South Range with highly evolved strontium (13) are major components in the precursor lithologies of the crystalline melt breccia.
3) The striking similarity of the time-corrected isotope ratios between the matrix of the crystalline melt breccia and the silicate melts of the Sudbury Complex substantiates the petrographic observations: We therefore suggest that the matrix of the crystalline melt breccia was formed by an early phase of the silicate melts which intruded the floor of the Sudbury impact crater, 1.85 Ga ago, and is a part of the Sudbury Igneous Complex. The rapid cooling caused by the high content of cold lithic clasts prevented the total assimilation of these fragments by the hot intruding melt. Oxygen isotope data (15) which show that assimilation of Onaping material was a major factor in the formation of the granophyre in line with our interpretation. On the basis of a Sm-Nd study, (12) suggested that the Sudbury Igneous Complex is formed by melts triggered in the upper crust by meteorite impact, is it the impact melt? **References**: (1) PYE E.G. et al. (1984). Ontario Geol. Surv. Spec. Vol.1, 603p. (2) DIETZ R.S. (1964). J. Geol., 72: 412 p.. (3) MUIR T. (1984). In: PYE E.G. et al.(ed.). Spec. Vol.1: 449-489. (4) STEVENSON J.S. (1972). In: GUY-BRAY, J.V. (ed.). Geol. Assoc. of Can., Spec. Pap.10: 41-48. (5) DRESSLER B.O. 1984b. In: PYE E.G. et al. (ed.) Spec. Vol., 1: 97-136. (6) KROGH T.E. et al. (1984). In: PYE E.G. et al.(ed.) Spec. Vol. 1: 431-446. (7) MUIR T. & PEREDERY W.V. (1984). In: PYE E.G. et al.(ed.). Spec. Vol.1: 139-210. (8) POHL J. et al. (1977). In: RODDY D.J. et al.: Impact and explosion cratering, Pergamon Press, 343-404. (9) STÖFFLER D. et al. (1979). Proc. Lunar Planet. Sci. Conf., 10th: 639-675. (10) FLEET M.E. et al. (1987). Can. Miner., 25: 499-514. (11) DEUTSCH A. et al. (1988) Lunar and Planet.

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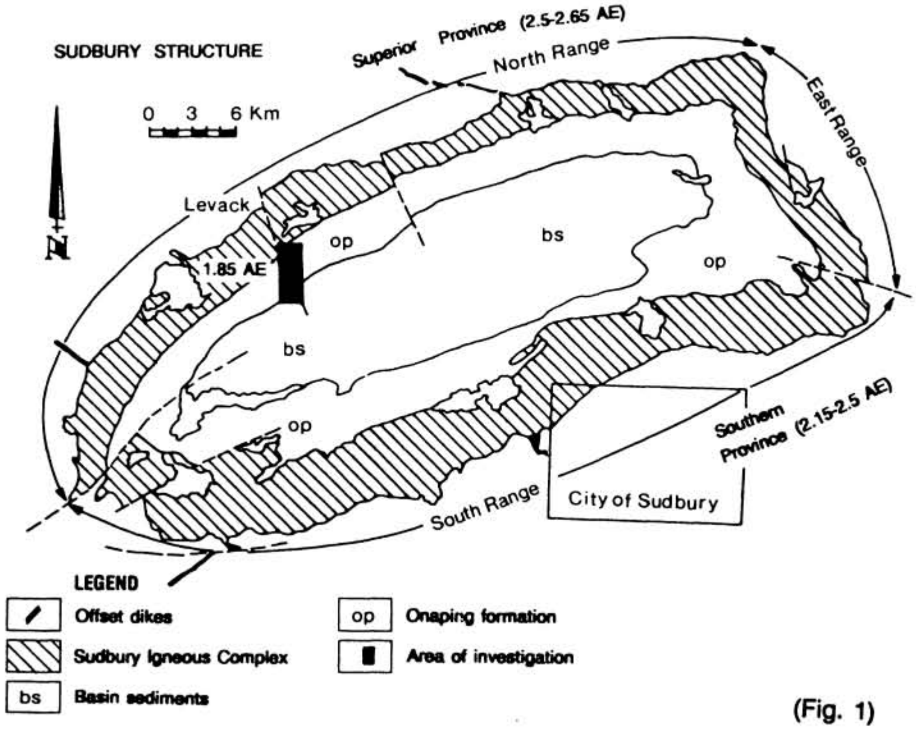
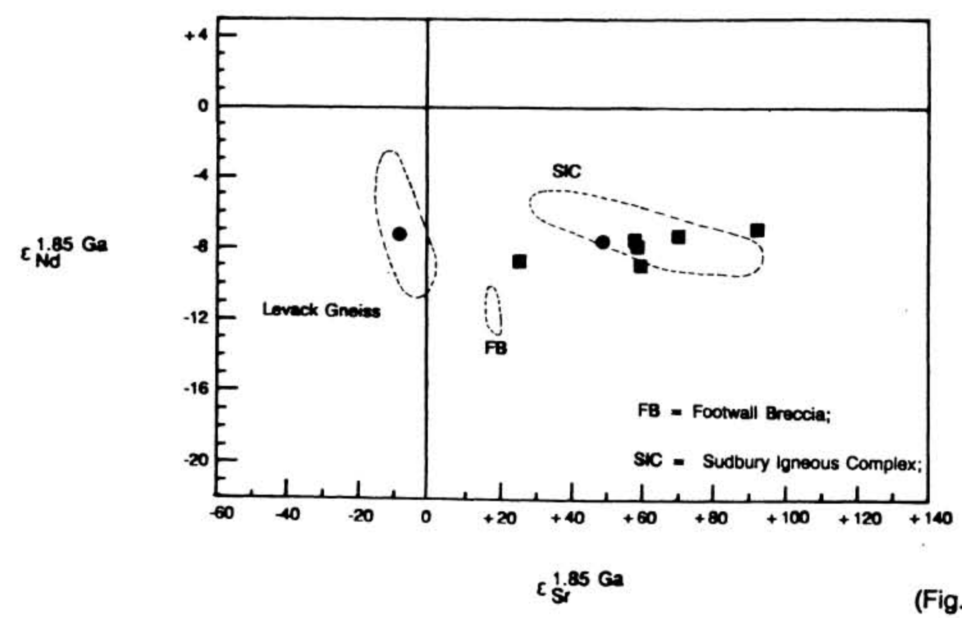



(Fig. 1)




(Fig. 2)