MICROSCOPIC FRAGMENTS OF AN ANGRITE-LIKE ASTEROID IN 5.28 MA IMPACT MELT BRECCIAS FROM BAHÍA BLANCA, ARGENTINA. R. S. Harris[1,2] and P. H. Schultz[1], [1]Dept. of Geological Sciences, Brown University, Providence, RI 02912, [2]Dept. of Geosciences, Georgia State University, Atlanta, GA 30302 (rsharris@gsu.edu).

Introduction: An asteroid impact in the vicinity of Bahía Blanca, Argentina approximately 5.28 (±0.04) Ma created a wide strewn field of glassy ejecta containing shocked quartz and plagioclase, coesite, and a variety of ultra high-temperature products [1-3]. Some of the melt breccias also contain small (<1mm) exotic clasts which we interpret to be surviving fragments of the bolide. Here we report the mineralogy of these remains and discuss some of the interesting aspects of their petrogenesis.

Angrite-like Assemblages: The clasts generally are fine-grained quenched basalts composed of intergrown laths of fassaitic pyroxene and plagioclase (Fig. 1). Plagioclase may contain significant iron (3-5 wt % FeO_{tot}), and fassaite may be phosphorous-rich. Both species sometimes alternate with blades of Ca-silicophosphate (Fig. 2). Although most of the blades are too narrow for electron microprobe work, a few were wide enough to analyze. They appear likely to be Mg-rich members of a Ca-Mg-Fe solid solution with some silicophosphate species reported from Asuka 881371, Sahara 99555, and D'Orbigny [4, 5]. The assemblages typically contain microphenocrysts of Si-bearing Ca-merrillite or fluorapatite (Fig. 3). MgO concentrations in merrillite exceeds 5 wt%, and Na is virtually absent. We also observe scattered titanomagnetite and isolated grains of awaruite and Ni-metal.

All of these characteristics suggest an affinity with known angrites [e.g. 6-8]. (Ironically, D'Orbigny lies at the margin of the impact strewn field.) However, the alkali concentrations in plagioclase (An_{65-84}) and Fe/Mn rations for clinopyroxene (~30-40) are not indicative of angrites, and possibly are more similar to eucrites [e.g., 9, 10]. Although An_{100} is a hallmark of angritic feldspars, Prinz et al. [11] did report An_{86} for some rare plagioclase from Angra dos Reis. If the Bahía Blanca impactor is related to the angrite suite, it might suggest that that Prinz's analyses, which widely have been dismissed as contamination from eucrites studied in the same lab, should be reconsidered.

But the plagioclase grains in our samples are even more volatile-rich. Despite the other, nearly unique, similarities with angrites, we have had to consider the hypothesis that the fragments represent another type of, perhaps unclassified, body. We also have evaluated the possibility that the fragments could be terrestrial material altered by the Bahía Blanca event.

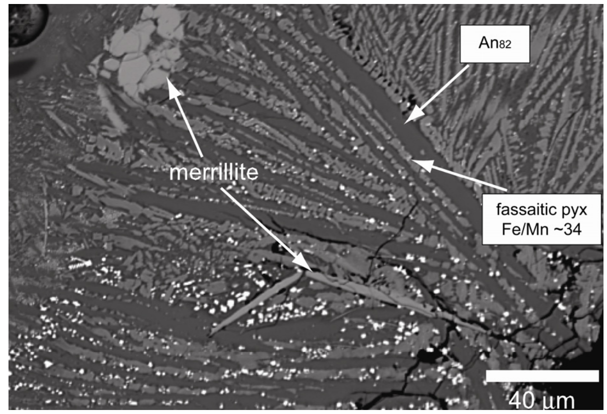

Figure 1. Backscattered-electron (BSE) micrograph showing a small fragment of meteoritic basalt that survived the 5.28 Ma Bahía Blanca impact event. The clast is composed of bytownite, fassaitic pyroxene, and Ca-merrillite.

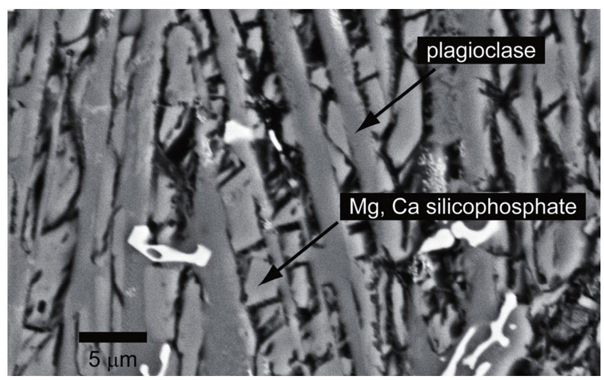

Figure 2. BSE electronmicrograph showing a close-up of a fragment composed of plagioclase, titanomagnetite (white), and magnesium-rich Ca silicophosphate.

The Case for an Angritic Origin: Although the plagioclase grains in the Bahía Blanca fragments range from An_{-84} down to An_{65}, they exhibit a rather uniform trend. The higher Na concentrations show commiserate K enhancements (Fig. 4). When K (afu) is plotted against An% (following [9, 10]), they form a linear array to the right of HED and lunar basalts at high An% and parallel to the trends of terrestrial and Martian alkali basalts at lower An%. The plotted values result from recalculations of high-precision electron microprobe analyses replicated with excellent agreement on instruments at Brown University and the University of Georgia.

The high K concentrations at lower An% support other arguments that these clasts are not terrestrial material altered by the impact, else the event would have had to simultaneously add and deplete elements that should have been similarly volatile under impact conditions—and do so in a quite regular fashion.

The observed trend seems compatible with the possibility that these fragments represent alkalic melts derived from magmatic evolution on an angritic, or at least angrite-like, parent body.

Additional Considerations: Although a source crater has not been identified for the Bahía Blanca ejecta, the volume and aerial distribution of glass suggests that the impactor was at least a few hundred meters in diameter. We have linked these glasses geochemically to microtektites reported [12] from the South Tasman Rise, so the event and the bolide may have been even larger. The meteoroid may have contained a much more diverse sampling of an angritic asteroid than is represented by our collection of meteorites, including significant regolith. These small fragments preserved in the impact melt may represent a random sampling of fine-grained volcanics that had remained buried in that debris for eons. Of course, if these fragments do represent alkalic magmatism on even an angrite-like body, it could have important consequences for modeling the sizes and/or thermal budgets of early differentiated bodies.

References: [1] Schultz, P. H. et al. (2006) *Meteor. Planet. Sci., 41,* 749-771. [2] Harris, R. S. and Schultz, P. H. (2006) *LPS XXXVII*, abstract #2272. [3] Harris, R. S. and Schultz, P. H. (2007) *Geol. Soc. Am.. Abstracts with Programs, 39*, 371. [4] Kaneda, K. et al. (2001) *LPS XXXII*, abstract #2127. [5] Mikouchi, T. et al. (2001) *11th Goldschmidt Conf.*, abstract #3659. [6] Mittlefehldt D. W. et al. (2002) *Meteor. Planet. Sci, 37,* 345-369. [7] Mikouchi T. et al. (2003) *Meteor Planet. Sci*., *38*, A115. [8] Jambon A. et al. (2005) *Meteor. Planet. Sci, 40,* 361-375. [9] Papike, J. J. et al. (2003) *Am. Min.*, *88* , 469-472. [10] Karner, J. et al. (2004) *Am. Min.*, *89* , 1101-1109. [11] Prinz, M. et al. (1977) *Earth Planet. Sci. Lett., 35*, 317-330.[12] Kelly, D. C. and Elkins-Tanton, L. T. (2004) *Meteor. Planet. Sci., 39,* 1921-1929.

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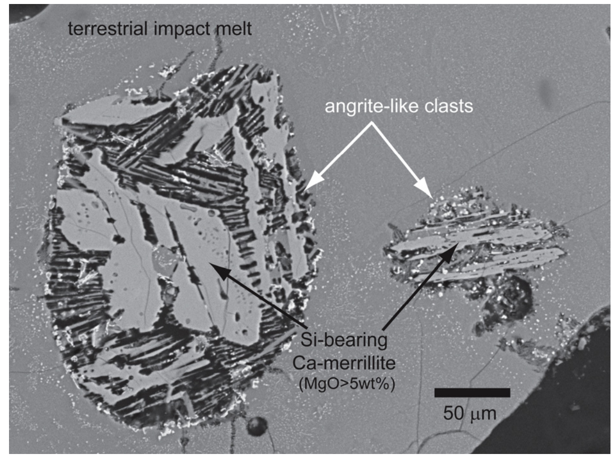

Figure 3. BSE electronmicrograph of impact melt containing two angrite-like clasts composed of intergrown plagioclase, fassaitic pyroxene, and silicophosphates larger grains of Si-bearing , Na-free Ca-merrillite.

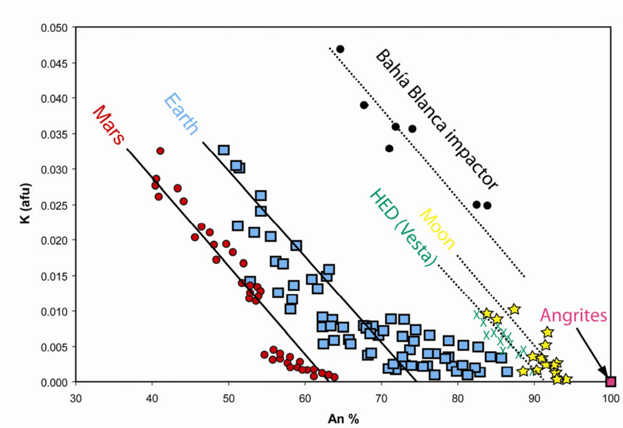

Figure 4. K (afu) vs. An% in basaltic plagioclase from several planetary sources (adapted from Papike et al. [9] and Karner et al. [10]) including the Bahía Blanca bolide. Those surviving fragments could be consistent with alkalic melts derived from an angritic parent body.