THE PETROFABRIC IN CB_a GUJBA – COMPARISON TO $CV3_R$ CHONDRITES AND A TERRESTRIAL ASH-FLOW TUFF.
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Introduction: Gujba is the least-deformed member of the CB_a coarse-grained subgroup of Bencubbin-like chondrites [1,2]. CB_a rocks consist mainly of ellipsoidal kamacite globules containing varying amounts of troilite, light-colored chondrule-like silicate globules, and dark-colored, fine-grained silicate-rich matrix material. They are characterized by abundant metallic Fe-Ni, large depletions in moderately volatile elements, and large enrichments in $\delta^{15}N$ [1]. Weisberg and Kimura [3] reported high-pressure phases (majorite, possibly majorite-pyrope$_{ss}$, wadsleyite and coesite) in the matrix and in silicate globule fragments in Gujba, indicative of minimum shock pressures of ~19 GPa. Most researchers have modeled CB_a chondrites as non-nebular objects produced in an impact plume by condensation of metal and silicate globules that subsequently settled to the surface of the target asteroid [2,4,5].

Bencubbin and Gujba both exhibit preferred orientations of their major components [2,6]. There are two principal ways such petrofabrics could have formed: (a) *Flow deposition*, as in many terrestrial ash-flow tuffs [7,8] (in some cases, particularly in welded tuffs, this is accompanied by compaction, flattening and stretching [9,10]) and (b) *Shock-induced shearing*, as invoked previously for OC, CM2.0, $CV3_R$ and $CV3_{OxB}$ chondrites [11-17]. To distinguish between these possibilities we measured the petrofabrics of several samples: (a) the cut surface of a specimen of Gujba (24 cm^2), (b) a slab of $CV3_R$ Leoville (6 cm^2), (c) a thin section of $CV3_R$ Y-981208 (0.46 cm^2) and (d) the cut surface of an ash-flow tuff from Battleship Rock, Jemez Mountains, New Mexico (9.2 cm^2). Because metal tends to deform in a ductile fashion and silicates in a brittle fashion, we measured the orientation of fractures in three Gujba silicate globules and compared them to those in brittle solids deformed by compressive stress.

Petrofabrics: *Gujba (CB_a)*—this rock has a strong petrofabric. The mean deviation from the median azimuth is similar for the silicate globules (0.7º±24º; n=16) and metal globules (1.8º±23º; n=40); the deviation for all globules is (0.6º±23º; n=56). *Leoville ($CV3_R$)*—this chondrite has a pronounced petrofabric [18]. The mean deviation from the median azimuth for chondrules, refractory inclusions and metal globules in our new data is 0.4º±15º (n=105). *Y-981208 ($CV3_R$)*—this chondrite has a strong petrofabric [17]. The mean deviation from the median azimuth for chondrules in our new data is 4.0º±27º (n=33). *Battleship Rock ash-flow tuff*—this rock has a very strong petrofabric. The mean deviation from the median azimuth for the major components is 2.0º±15º (n=44); the strength of the petrofabric is similar to those of other terrestrial ash-flow tuffs [10] (as well as $CV3_R$ Leoville).

Fractures in Gujba silicate globules: We measured the principal fractures in three silicate globules relative to the median azimuthal angle of the globules. There appear to be two principal sets of fractures. The fractures in Globule 1 peak at 10-15º; the peak contains 12% of the fractures. Those in Globule 2 peak at 25-30º; the peak contains 16% of the fractures. (The fractures in Globule 3 are more uniformly distributed.)

Discussion: The petrofabric of Gujba is very similar to that of the two $CV3_R$ chondrites we measured and to the other CM2.0, $CV3_R$ and $CV3_{OxB}$ chondrites measured previously [17]. It is likely that all these rocks formed by the same deformation mechanism, i.e., heating, fracturing and squeezing into adjacent pores induced by shock [14,16,17,19]. The angles of the fracture sets in the Gujba silicate globules closely resemble those of rock samples subject to uniaxial compressive stress (which have peaks at 12-18º and ~30º relative to the sample axis [20]). This is consistent with the deformation in Gujba being caused by shock-induced compression and with the occurrence of high-pressure minerals in this meteorite [3].

The very stong petrofabric (reflected by a relatively low standard deviation) and the extremely elongated and stretched components of the Battleship Rock ash-flow tuff suggest formation by a different process, i.e., mainly by flow deposition, as documented in other ash-flow tuffs [7,8].

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