DISCUSSION

CHONDRITIC FEATURES IN A DIAMONDIFEROUS ROCK, MAJHGAWAN, CENTRAL INDIA: IMPLICATIONS FOR DIAMOND GENESIS by Fareeduddin.

Jour. Geol. Soc. India, v.68(5), pp.743-760.

(1)

Sambhunath Ghosh, Director, Geological Survey of India, Petrology Division, Eastern Regions, DK-6, Sector II, Salt Lake City, Kolkata – 700 091 comments:

1. In meteorites, micro-diamonds have been reported so far from achondrites *Urellite group) which contain olivine, pigeonite, pyroxene, carbon matrix and metal (Fe-Ni alloy). This carbon matrix is essentially graphite that produces micro-diamonds in micron scale under shock-impact. Chondrites including carbonaceous variety do not contain much carbon in the matrix and so the chance of micro-diamond occurrence is next to impossible. In context of the above, size and abundance of micro-diamonds of Majhgawan kimberlites as mentioned seems to be exclusively of melt origin and not from impact of extra-terrestrial bodies.
2. Presence of chondrites (barred olivine, porphyritic olivine) or chondrule-like (CL) structure confirm chondritic impact if the composition of olivine and matrix adjacent to barred olivine is known by EPMA. Besides, olivine of meteorites are always fresh compared to reported serpentinised olivine.
3. Several interesting shock-induced structures have been presented and these are very much convincing. When olivine shows all sorts of shock features up to selective in-equilibrium melting, then shock transformation from olivine to ringwoodite is expected at lower pressure than melting of olivine. This feature is lacking in the report.
4. Mention has been made about "metal" and metal is confirmatory element to chondrule. I find the composition of metal spherules are all Ti-rich and cannot be related to meteorite. Presence of Ti, Ba and Fe is supportive of terrestrial origin. Have any metal composed of Fe, Ni, Co been found?
5. Finally, whether it is explosive eruption or, it is due to hypervelocity impact, huge amount of stress would be generated and part of it would be used for mechanical fragmentation, part of it would be used to generate temperature and other part would be absorbed and resorbed in the host rock. Difference would be of duration in minutes and hours for the former and in microseconds in the latter.

Apart from laboratory evidence one needs to collect other evidence in favour of relatively slow or, very fast impact and search for evidence of impact in the field to establish whether the fracture system is due either to (a) shock-generated fracturing and inward tilting of strata, or , (b) fracturing caused by forceful emplacement of crater facies to the crustal level and outward tilting of strata or due to combination of both.

Fareeduddin, Geological Survey of India, PPOD Division, AMSE Wing, Bangalore – 560 078; **Email:** fareedromani@hotmail.com replies:

1. I would like to draw the attention of Dr. Ghosh to several papers that have recorded diamond grains in virtually all chondritic meteorites (Nuth, 1990; Huss, 1990). To asses the distribution of diamond as a function of meteorite class and metamorphic history, Huss (1990) studied primitive, ordinary (LL, L, H), carbonaceous (Cl, CV) and enstatite chondrites. He showed that diamonds were incorporated in all the chondrite groups and their abundances decreases with increasing grade of metamorphism. To state that 'it is impossible to get diamonds in chondritic meteorites' would not be correct.
2. Barred olivine was noticed in a thin section with a cover glass and therefore was not amenable for micro-beam studies. Olivines from some carbonaceous chondrites are serpentinised (Tomeoka and Buseck, 1985; McSween Jr., 1979). In such cases it is interpreted to represent product of aqueous alteration. In the present case, the bolide matter is billion year old and therefore serpentinisation of olivine from such older body is only to be expected.
3. It is heartenting to note that Dr. Ghosh is convinced about the shock features. Ringwoodite is not recorded in Majhgawan and therefore is not reported.

Ringwoodite is neither reported from Popigai impact structure which accounts for millions of carats of diamonds and also contain a variety of impact melts (Deutch et al. 2000).

4. I agree with Dr. Ghosh that many of the metal spherules may not have chondritic lineage. In my study, I could not find any spherule exclusively composed of Fe, Ni or Co in Majhgawan.
5. I concur with Dr. Ghosh regarding energy dissemination process vis-à-vis time scale of the different processes.

I agree that a more detailed study is called for, particularly in areas surrounding the Majhgawan body.

(2)

S. Viswanathan, 503/23-C MHADA Complex, Hiranandani, Powai, Mumbai – 400 076; **Email:** sviswam123@yahoo.com, comments:

1. Instead of naming the rock simply ultramafic breccia, it is perhaps preferable to call it Impact Ultramafic Breccia (IUB) to distinguish it from the sedimentary, volcanic (effusive) and fault (tectonic) breccia.
2. What is the status of the ultramafic body in the stratigraphic sequence given in Table 1?
3. The plots of the ultramafics indicate their lherzolitic parentage with high TiO_2 influx from the meteorite shower.
4. To what depth does the author surmise that the shock metamorphism could have affected the igneous suite?
5. When did the chondritic impact take place after the emplacement of the ultramafic body?

Fareeduddin, Geological Survey of India, PPOD Division, AMSE Wing, Bangalore – 560 078; **Email:** fareedromani@hotmail.com replies:

1. The rock has been named as ultramaifc breccia as against the plethora of names available for this rock in order to highlight the importance of a breccia of ultramafic composition. Its naming as IUB awaits detailed field studied involving Majhgawan body and adjacent Vindhyan rocks along the line suggested in the paper.
2. In order to account for the presence of xenolithic fragments, the Majhgawan body has been placed above Kaimur Group and below Rewa Group (Mathur and Singh, 1971). The impact possibly occurred about a billion years ago, much before the deposition of the Rewa sediments. This interpretation does not influence the position of the Majhgawan body in the stratigraphic sequence envisaged for the region.
3. The higher titanium in the rock could have been from the lherzolitic mantle source or even could have segregated from the impact melts. The electron probe study by the author has indicated presence of several exotic titanium phases whose origin is not clear.
4. Whereas it is easier to identify the intensity of shock event with the help of shock metamorphic features it is difficult to infer the depth to which the shock metamorphism could have affected the target rocks.
5. The interpretations provided in the paper is that the Majhgawan body represents an impact triggered mantle eruption and that the erupted volcanic material preserve the xenolithic fragments of the impactor (chondritic meteorite) and the target lithologies (Vindhyan sediments).

References

Deutsch, A., Masaitis, V.L., Lagenhorts, F. and Grieve, A.F. (2000) Popigai, Siberia – well preserved giant impact structures, national treasury and world's geological heritage. Episodes, v.23, pp.3-11.

Huss, G.R. (1990) Ubiquitous interstellar diamond and SiC in primitive chondrites: abundance reflect metamorphism. Nature, v.347, pp.159-162.

Mathur, S.M. and Singh, H.N. (1971) Petrology of the Majhgawan pipe rocks. Geol. Surv. India, Misc. Publ. no.19, pp.78-85.

McSween, Jr., H.Y. (1979) Alteration in CM carbonaceous chondrites inferred from modal and chemical variations in matrix. Geochim. Cosmochim. Acta., v.43, pp.1761-1770.

Nuth, J. (1990) Diamonds are for everywhere. Nature, v.347, pp.125-126.

Tomeoka, K. and Buseck, P.R. (1985) Indicators of aqueous alteration in CM carbonaceous chondrites: microtexture of a layered mineral containing Fe, S, O and Ni. Geochim. Cosmochim. Acta, v.49, pp.2149-2163.