

UNIVERSAL-STAGE MEASUREMENTS OF PLANAR DEFORMATION FEATURES IN SHOCKED QUARTZ GRAINS RECOVERED FROM RAMGARH STRUCTURE Vaibhav Purohit and M S Sisodia. Department of Geology, J N Vyas University, JODHPUR 342005, sisodia.ms@gmail.com

Introduction: Ramgarh Structure (N25°20': E76°37') located in Baran district of Rajasthan is a 3.5 km diameter annular feature with a depressed interior surrounded by a raised rim having steep inner flanks and shallow outer flanks. The structure is obvious as a crater in topographic maps and satellite imageries as it is located in a flat sedimentary terrain of Vindhyan Supergroup. The features observed in this structure include: impact spherules, diaplectic glasses, specific crater morphology, brecciation, multiple striated joint surfaces, swinging strike, radial folds, deformed central uplift particularly in the absence of any igneous activity, planar fractures along crystallographic planes, irregular extinction and mosaicism, toasted quartz, isotropic grains and patches as well as planar deformation features (PDFs) and decorated PDFs with occasional ghost traces of original PDFs, accretionary lapilli, high Ni content and also anomalous Cr and Co. [1 to 8]. However measurements of PDF orientation within the quartz grains using standard petrographic procedures on U-stage that distinguishes them from planar structures produced due to non-shock processes were not done hence some authors are still not convinced regarding the origin of Ramgarh structure by meteorite impact [9 to 11]. In this paper the result of the measurements done on a four axis Federov universal stage [12] of quartz grains are discussed.

Microscopic observation of shocked quartz grains: It is to be noted that the PDFs commonly observed in thin sections of the samples collected from the Ramgarh Structure are not very well defined. Most of the PDFs are probably annealed that may possibly be due to recrystallization along the cleavage planes and subsequent development of what are known as 'decorations' [13]. Sandstone samples collected from the central peak (in the vicinity of the ancient temple) of the Ramgarh structure showed few quartz grains that contain one or more than one set of planar cleavages (PDFs) showing spacing between two successive cleavages as close as 2 μm (Figures 1 to 3). Two of these quartz grains, which showed more than one set of PDF were studied for PDF orientations using a Universal stage. Some quartz grains showed very well developed one set of PDF but it is

difficult to measure their cleavage angles. PDF orientations were measured using standard petrofabric procedures on a U-stage.

Method of study: The measurements of the crystallographic orientations of PDF using a Universal stage is done to find out the angle between the c-axis and the pole of the plane of the PDF as well as the azimuthal angle in quartz grain [12, 14 to 17]. Two quartz grains with more than one PDF planes in two different sections were studied and the measurements were made on the four axis Federov universal stage. The optic axes (c axis) for both the grains were found to lie in the equatorial plane. The raw U-stage data was recalculated to Silva Compass orientation represented in Clar's notation (dip direction/dip of pole, e.g. 270/15). The c-axis is rotated to the center of the stereographic projection together with all the poles to planar features while retaining the angular relations between them. The classical U-stage measurement technique without indexing was performed as only two grains with PDF could be studied. This technique involves plotting angular data between quartz c-axis and poles to planar features in binned intervals. Stereo32v1.1 was used by the authors [18].

Result: The study of the two quartz grains with PDF in two different planes has revealed decorated PDF along crystallographic planes of quartz in target sandstone, which have still retained the crystallographic orientation of the original PDF namely: r, z $\{10\bar{1}1\}$, $\{01\bar{1}1\}$, ω , ω' $\{10\bar{1}3\}$, $\{01\bar{1}3\}$, x $\{51\bar{6}1\}$, $\{65\bar{1}1\}$, s $\{11\bar{2}1\}$, $\{2\bar{1}11\}$, $\{22\bar{4}1\}$, $\{4\bar{2}21\}$ (Tables 1 and 2) thus confirming the cleavage planes studied as PDF. The histogram made from the polar angles, i.e. angle between the c axis of the quartz grain studied and the Pole to PDF reveals the concentration of the PDF to be along the angles 52°, and 23° i.e. r, z $\{10\bar{1}1\}$, $\{01\bar{1}1\}$, ω , ω' $\{10\bar{1}3\}$, $\{01\bar{1}3\}$. [19,20]. The Crystallographic forms of the PDF poles are described after Ferriere [21]. The above-mentioned petrographic observations are indicative of the meteorite impact origin of the Ramgarh Structure. The recognition of PDF in the two quartz grains studied, by finding their crystallographic orientations using the Universal Stage can be taken as unambiguous evidence of the impact

origin of this structure.

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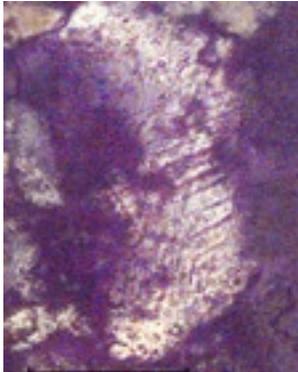


Fig.1 Quartz grain 1 showing PDF in two planes. Crossed Nicols, 20 x.

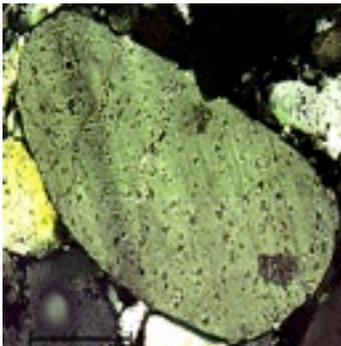


Fig.2 Quartz grain 2 showing PDF in two planes, Crossed Nicols, 20 X

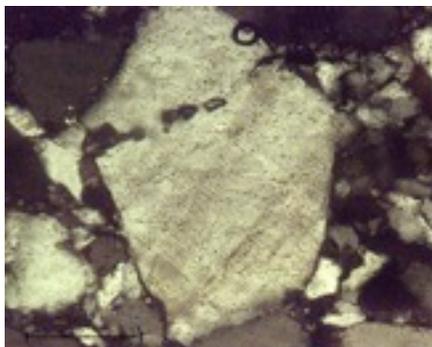


Fig.3 Quartz grain showing PDF in one plane. Crossed Nicols, 20 X

Polar Angle (Angle between the PDF pole and the c axis of quartz) in degrees	Symbol	Miller-Bravais Indices (hkl)	Crystallographic Form
55	-	-	-
133	-	-	-
116	-	-	-
112	-	-	-
115	-	-	-
126	-	-	-
143	-	-	-
145	-	-	-
82	x	{31̄61}, {6511}	Trigonal trapezohedron
66	s	{112̄1}, {2111}	Trigonal dipyrmaid
52	r, z	{101̄1}, {0111}	Rhombohedron
57	-	-	-
77	-	{224̄1}, {4211}	Trigonal dipyrmaid
60	-	-	-
61	-	-	-
123	-	-	-
143	-	-	-

Table 1 Crystallographic orientations of the PDFs found in Quartz grain 1

polar Angle (Angle between the PDF pole and the c axis of quartz) in degrees	Symbol	Miller-Bravais Indices (hkl)	Crystallographic Form
26	-	-	-
46	-	-	-
52	r, z	{101̄1}, {0111}	Rhombohedron
151	-	-	-
150	-	-	-
11	-	-	-
12	-	-	-
12	-	-	-
11	-	-	-
23	o, o'	{101̄3}, {0113}	Rhombohedron

Table 2 Crystallographic orientations of the PDF found in quartz grain 2.

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