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21 August 1967

Deformation Lamellae Parallel to (10$\bar{1}$3) and (0001) in Quartz of the Coeur d'Alene District, Idaho

Abstract. *Deformation lamellae oriented parallel to the (10$\bar{1}$3) and (0001) crystallographic planes in quartz have been considered to be deformation structures unique to shock metamorphism induced by meteorite impact. Rocks of the Belt Supergroup of the Coeur d'Alene district, Idaho, contain quartz with deformation lamellae parallel to both (10$\bar{1}$3) and (0001). All available evidence indicates a geotectonic rather than an astrotectonic origin for the deformation lamellae of the district. Therefore, the uniqueness of these orientations to astrotectonic deformation is doubtful.*

Recently there has been considerable interest in establishing petrographic criteria for the recognition of structures formed by meteorite impact. Experimental deformation of rock specimens by hypervelocity shock waves has produced what are considered to be unique indicators of shock deformation (*1*). Among these unique indicators are multiple sets of planar lamellae in quartz, with preferred orientation parallel to (10$\bar{1}$3) and, less strongly, parallel to (0001) crystallographic planes. The uniqueness of these deformation structures is based largely on the failure to produce lamellae of these orientations in experimental deformation of quartz under low rates of strain and on the absence of reports of similar orientations from geotectonically deformed rocks (*2*).

Accepting the uniqueness of (0001) and (10$\bar{1}$3) lamellae, French (*1*) argues that their presence in quartz of the Onaping Formation at Sudbury, Ontario, is evidence that the Onaping was deposited immediately after a meteorite impact that formed the Sudbury basin.

I report here that orientation of deformation lamellae parallel to the (10$\bar{1}$3) and (0001) planes of quartz was found in rocks having no apparent meteorite impact history. Clearly, the scarcity of available reports on deformation lamellae makes arguments based on negative evidence rather tenuous. By this presentation I hope to encourage additional studies of geotectonic structures before the uniqueness of the criteria for recognition of astrotectonic structures is accepted.

The microfabric of the rocks of the Belt Supergroup in the Star Mine, Coeur d'Alene district, Idaho, was examined by me in 1964–65 to provide data for a study of deformation around mine openings (*3*). During the microfabric study, I became aware that, contrary to the report of Carter (*4*), deformation lamellae were occasionally oriented parallel to the basal plane (0001) of quartz. Deformation lamellae are predominantly parallel to (10$\bar{1}$3) of quartz in the samples from the Star Mine. At the time, the observation by itself did not appear to warrant reporting; but now the lack of available reports of such lamellae has led writers to conclude that these orientations are not to be found in geotectonically deformed rocks. The rocks of the Coeur d'Alene district have been complexly deformed and, despite the long history of mining in the area, no extensive microfabric-megafabric structural analyses have been made. However, in the available studies of the megastructure, the most recent of which is Hobbs *et al.* (*5*), no evidence is presented to suggest any extraterrestrial effect.

Samples from the Star Mine were collected from the walls of mine openings. Therefore, all samples had been affected by relatively low-velocity shock during blasting. Because of the limited nature of the study, the degree of deformation attributable to blasting was not determined directly. The statistical pattern of quartz lamellae paralleled the patterns of healed and unhealed microfractures in quartz and the major joint sets in the area. Therefore, it is thought probable that the lamellae are geotectonic rather than blasting features.

Of the samples examined, approximately 10 percent of the quartz grains studied contained deformation lamellae. Of 160 planes measured, five were parallel to (0001) and 48 were parallel to (10$\bar{1}$3). The accuracy of measurement is considered to have been ± 4°.

It is beyond the scope of this report to explain why basally oriented quartz lamellae are present in the rocks of the Coeur d'Alene district and apparently absent in other areas. One might observe that in sections containing basally oriented lamellae more orientation planes are represented, with a consequent reduction of the frequency of the (10$\bar{1}$3) plane. This suggests that under certain combinations of preferred quartz orientation and subsequently applied stress, easy directions and planes of translation in quartz are inopportunely oriented, and stress is accommodated on planes of greater resistance.

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11 October 1967

Radiocarbon Content of Marine Shells from the Pacific Coasts of Central and South America

Abstract. *The radiocarbon content of contemporary pre-bomb marine shells from the region of upwelling of the Pacific coast of South America has been determined and found to be somewhat similar to the content of shells from the coast of California and the west coast of Mexico. Deviations of up to −8.5 percent with reference to the contemporary biospheric carbon-14 standard have been observed for the Peruvian coast. Values of from −0.35 to −4.04 percent have been obtained for marine shells from the Galápagos group. Problems associated with radiocarbon dates based on shells are discussed.*

In an earlier investigation the content of radiocarbon in contemporary pre-bomb marine shells from the region of upwelling of the California coast and the west coast of Mexico was determined in order to estimate the general magnitude of the upwelling effect as expressed by the apparent radiocarbon age (*1*). A knowledge of this fictitious age is also of considerable consequence in the application of radiocarbon dating to marine shells found in archeological sites, provided oceanic conditions since ancient times have not changed markedly.

This study has now been extended to the Pacific coasts of Central and