SCANNING ELECTRON MICROSCOPIC STUDY OF QUARTZ GRAINS OF DOKRIANI BAMAK (GLACIER), GARHWAL HIMALAYA, INDIA

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Dokriani Bamak (glacier) is located in the Garhwal Himalaya, west of Gangotri Glacier, between 31°49' to 35°20' north longitude and 78°74' to 78°51' east longitude. This glacier is one of the glaciers on the southern slopes of the Gangotri group. It is a valley glacier. The meltwater of Dokriani Bamak forms the Din Gad, a tributary of Bhagirathi river, which joins the Bhagirathi river near Bhukhi village 52 km from Uttarkashi on the way to Gangotri temple.

The glacier originates from two cirques in the vicinity of Janoli (6,633m) and Draupadi ka Danda (5,716m). The ice flowing from the two cirques join at a height of 4,800m and form a fall. This ice-fall cascades down in a NNW direction from a height of 4,800 to 4,300m, then takes a turn in the westerly direction. At the base of ice-fall, ogives are developed. On the convex side of the turning zone of the glacier from NNW to W, a zone of stagnation on the margin of the glacier has developed. The glacier is free of large crevasses till it comes down to a height of 4,200m. It then moves through a 100 to 150m-wide crevassed zone, and finally terminates at a height of 3900 m. The total height of the glacier is 5.5 km.

At present, the Dokriani Bamak flows between the lateral moraines of the last glacial period, which stand nearly 100 to 150 m above the present day level of ice surface. In the lower half of the ablation zone, the debris content is very high. This is reflected by the large cover of supraglacial debris towards the snout and formation of supraglacial moraines and latero-frontal dump moraines. The supraglacial debris consists largely of angular blocks and fragments of gneisses and schists. Dumping of latero-frontal-dump moraines has been active for past few years with the recession of the snout,

at a rate of nearly 10 m yr^{-1}. Latero-frontal dumping was observed from 1991 to 1994.

The right margin has its source in the headwall on the western slopes of Janoli ridge. Freeze and thaw processes, supported by strong solar radiation and large diurnal temperature changes at an altitude of over 4,500m accelerate the erosion of the headwall of cirque. This is leading to over-steeping and enlarging of cirques by shedding coarse debris into the glacier, most of which fall into the crevasses at the margin of the cirques. The debris of the left lateral marginal moraine deposits are generated in the headwall north of Draupati Ka Danda cirque. A large part of the debris falls in the open crevasses in ice-fall between an elevation of 4600 to 4800 m . Some of this debris gets engulfed into the ice to form englacial sediments and some of it falls down into crevasses to form subglacial sediments. The left marginal moraines emerge out of the surface of the glacier at a height of nearly 4,800m . On the other hand, the right lateral moraines are formed at a height of 4,350m . The difference in formation between left and right lateral moraines is largely due to sharp turns in the flow direction of the glacier from NNW to W in the height zone of 4,350 to 4,200m. The two marginal moraines move down almost parallel to each other to a height of 4,000m. From there on they merge into each other to form a continuous supraglacial debris cover. Sizeable portions of the supraglacial debris of the two lateral moraines fall into crevasses to form sub-space and englacial debris in second crevassed zone at a height of 4,200-4,100m. The fraction of supraglacial debris is also transported by supraglacial streams.

The major source of glacial debris in the Dokriani Bamak glacier comes from the cirque walls and the smaller fraction from the reworking of the old moraines. Grain size analysis was carried out to separate fine and very fine fractions (63-250 m) from glacial debris samples. An optical microscope was used to identify quartz grains and these were picked up for Scanning Electron Microscopic (SEM) studies. The surface textures of quartz grains through SEM have shown that quartz grains from supraglacial samples are mostly angular in shape. On the other hand, quartz grains from proglacial samples are largely subangular. Grains from old lateral moraines are angular to subangular. In the present study, it was observed that mechanical weathering is the predominant process. The evidence of chemical weathering has also been noticed.