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SIR,

Vertical dispersion of Chernobyl fall-out on Kesselwandferner, Oetztal Alps, Austria

In the accumulation area of Kesselwandferner (Oetztal Alps, Austria; 3250 m a.s.l.), snow samples were taken within an area of 10 000 m^2 in the years 1986–88. We have measured gross β-activity and gamma-activity of samples in vertical profiles contaminated by radioactive fall-out from the Chernobyl accident. Profiles in 1986 cover a depth range from the surface down to 1 m, in 1987 down to 6 m, and in 1988 down to 11 m (Ambach and others, 1987, 1988). This allows us to study the displacement of radioactive contamination in firn.

The depth range contaminated expands from the surface to 1 m (1986) to the range from 3 to 6 m (1987), and to the range from 5 to 11 m (1988). The upper boundary of the contaminated depth range migrates to greater depths due to net accumulation. Peak values of gross β-activity in vertical profiles are reduced by radioactive decay and by leaching out from 149 Bq/kg (1986) to 47 Bq/kg (1988). The upper boundary of the contaminated range serves as a significant marker, as the activity changes from the low natural background to high values. The lower boundary of the contaminated depth range is less clearly defined due to percolating melt water.

Whereas in 1986 samples ^{95}Zr, ^{95}Nb, ^{103}Ru, $^{103/106}$Ru/Rh, ^{110m}Ag, ^{125}Sb, ^{134}Cs, ^{137}Cs, and ^{144}Ce could be detected by gamma spectroscopy, in 1988 only traces of ^{110m}Ag, ^{106}Rh, and ^{125}Sb were detectable without significance. The main gamma-activity results from ^{134}Cs and ^{137}Cs contributing 13 and 87% to total gamma-activity.

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SIR,

Glacier ice-cored rock glaciers in the Yukon Territory, Canada?

An increasing number of measurements, soundings, and drillings has lead to the widely recognized concept that rock glaciers are morphological expressions of creeping mountain permafrost (for example, Gorbunov, 1983; Haeberli, 1985; Barsch, 1988; Belloni and others, 1988; Blumstengel and Harris, 1988; Carton and others, 1988; Giardino and Vitek, 1988; Haeberli and Schmid, 1988; Haeberli and others, 1988; Zhijiu Cui and Zhu Cheng, 1988; Evin, unpublished). The idea of rock glaciers developing from glaciers has never been based on any firm evidence from appropriate field measurements or reliable model calculations. After reviewing the presently available information from geothermal, electrical resistivity, radio-echo, and seismic refraction soundings, it has been concluded that relations between glaciers and rock glaciers are indirect, accidental, or non-existent (Haeberli, 1985, p. 122), and that the idea of an exclusively glacial origin of rock glaciers remains purely speculative (King and others, 1987, p. 94).

In their description of rock glaciers within the Dalton Range, Yukon Territory, Johnson and Lacasse (1988) claimed that rock glaciers form from glaciers which have become totally covered in debris. They made a strong point with this idea, implying that Barsch (1988), Gorbunov (1983), and myself (Haeberli, 1985) have overlooked an obvious and easily recognizable aspect of rock-glacier formation. They wrote that "continuity of glacier ice is visible ... from current glaciers through lateral moraines into rock glaciers". Such reasoning is not new (cf. Whalley, 1974, 1979; and earlier papers by P.G. Johnson as quoted by Johnson and Lacasse, 1988), but has repeatedly been criticized (for instance, Haeberli, 1985; Barsch, 1987) and does not gain credibility with time. The well-known fact that remains of buried snowbank and glacier ice, as well as other forms of massive underground ice (segregation ice, injection ice; cf. Shumskiy, 1955; Washburn 1979), can be embedded within rock glaciers is not in contradiction to the commonly accepted permafrost model of rock-glacier formation; at the same time, however, the potential inclusion of dead glacier ice by no means implies that rock glaciers as a whole can have a glacial (in contrast to periglacial) origin. The observations reported from Dalton Range even fit the concept of periglacial rock glaciers perfectly; the described rock glaciers are in a permafrost condition (Johnson and Lacasse, 1988, p. 331); the reported resistivity of the sub-surface material (10 000–15 000 Ω m; p. 329) is lower than the resistivity values measured in mountain glaciers, snowbanks, or dead glacier ice by several orders of magnitude and is typical for perennially frozen ground rich in ice (cf. Haeberli, 1985; King and others, 1987; Evin, unpublished; and the references given in these publications). Finally, the photographs illustrating the article (Johnson and Lacasse, 1988, p. 328, 329) do not show glaciers but a number of snow patches (a common feature of mountain permafrost), the dimensions of which are by orders of magnitude smaller than the dimensions of the discussed rock glaciers.

Johnson and Lacasse must have been aware of these points, because they quoted the corresponding literature. What is then the reason for yet again making a strong statement on the "glacial origin" of rock glaciers, a concept which can obviously not be "understood" but must be "believed" ? In view of the numerous definitive studies that have seriously challenged this long-standing belief, and in the absence of solid supportive evidence, Johnson and Lacasse's claim for a clear glacial origin for the rock glaciers they described has no merit. Moreover, the introduction of their cumbersome term "glacier ice-cored debris-system rock glacier" is unnecessary and most probably misleading.

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