Surface exposure ages of high elevation glacial erosion forms: an attempt to date deglaciation of the Last Glacial Maximum ice cap in the western Swiss Alps

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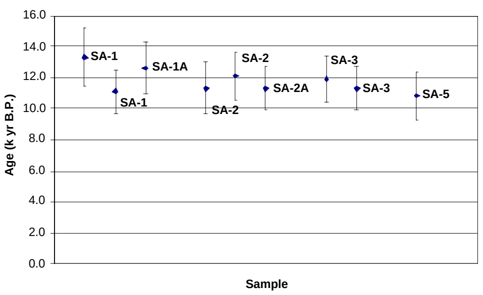
A reconstruction of the Last Glacial Maximum (LGM; approx. 18-20,000 yr B.P.) ice cap in the western Swiss Alps is based on high elevation glacial erosion features and provides a detailed representation of the former ice surface. Surface exposure dating is employed to determine the age of deglaciation from the last maximum ice surface. The timing of ice decay in the Alps is important for comparison with deglaciation on the Northern Alpine Foreland (NAF) as well as with the global ice age termination.

The cosmogenic nuclide ^{10}Be was measured in glacially eroded surfaces, 100-200 m below the maximum ice limit. Sampled surfaces were steeply inclined (40-90º) in an attempt to reduce the influence of a snow cover on the exposure ages.

^{10}Be dates indicate that the last Alpine ice cap is LGM age and are consistent with surface exposure dates of the last maximum ice extent on the NAF (Ivy-Ochs, 1996). ^{10}Be dates show that ice decay from the maximum level in the Saas Valley began by at least ~13,000 yr B.P. (Figure 1). This is 2500 yr after the initial deglaciation on the NAF.

Figure 1. ^{10}Be surface exposure dates from Saas Valley.



Although the ^{10}Be dates are minimum ages, it is likely that deglaciation occurred more slowly in the Saas Valley. Saas Valley, located in the southern Valais region of Switzerland, was the site of a large ice field during the LGM. This ice field was ~1400 m thick and responded to climatic warming more slowly than outlet glaciers on the NAF.

References Ivy-Ochs, S. (1996). ETH Dissetation No.11763, Zurich, 196 p.

Did the ancestral Hawaii plume interact with a mid-ocean ridge? The isotopic evidence

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The Hawaii-Emperor Seamount chain represents a record of mantle plume activity for at least 86 Ma. Systematic changes in incompatible element and Sr isotopic composition occur along the length of the chain, with the older seamounts showing much greater depletion than the younger Hawaiian lavas. In particular, the 81 Ma Detroit Seamount appears to have a MORB- like Sr isotopic composition, which Keller et al. (2000) attributed to the interaction of the Hawaii plume with a mid-ocean ridge in its earliest stages of evolution.

Following the recent success of ODP Leg 197, which penetrated a total of 1220 m into the basement of three Emperor seamounts (~80Ma Detroit, ~55Ma Nintoku, and 48Ma Koko), this hypothesis can be rigorously tested using Hf, Nd and Pb isotopes, coupled with trace element data.

Preliminary Hf-Nd isotope results for 65-85 Ma basalts recovered during DSDP Legs 19, 55 and 145 suggest that whereas younger seamounts trend towards Hawaiian compositions, the older Detroit Seamount has a similar range of _Nd to MORB. It is distinguished from MORB, however, by higher _Hf values for a given _Nd, suggesting the involvement of a distinct high _Hf component. A similar trend is seen for ^{207}Pb/^{204}Pb, where Detroit has less radiogenic composition than N-MORB. This distinction is also confirmed by Nb-Zr-Y systematics.

Together, the data suggest that the Hawaiian plume contains a depleted component (with higher _Hf than Pacific N-MORB), which was sampled by the Detroit Seamount. An analogous high _Hf component has been identified in the Iceland plume system, where it is attributed to the entrainment of hot depleted material into the margins of the plume (Kempton et al., 2000). Such a model, however, contradicts Keller et al.'s hypothesis that the depleted component at Detroit seamount is the result of interaction with a spreading ridge. Work in progress on the new samples recovered during ODP Leg 197 will allow this model to be evaluated more rigorously for the Hawaiian mantle plume system.

References

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