A comparison of cosmogenic chronologies for deglaciation in western North America and Europe

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A fairly detailed record of deglaciation has been available from some parts of western Europe for several decades. Similarly detailed reconstructions from other parts of the world have only recently been produced. Cosmogenic ^{36}Cl dating studies carried out in the Sierra Nevada of California and in the British Isles provide a basis for direct correlation of deglacial chronologies from these two regions. A comparison of the chronologies demonstrates a high degree of synchroneity. Glaciers reached their maximum extents at 22-21 ka (cal) in both areas. An initial period of gradual retreat was followed by rapid ice wasting at 18-17 ka. At about 16.5 ka ice in both areas began to readvance. This readvance did not achieve the full extent of the LGM ice before a precipitous retreat was initiated at about 15.5 ka. Ice appears to have virtually disappeared from both areas within less than a thousand years. Both regions were apparently ice-free until approximately 12.5 ka when glaciers reappeared for a minor and brief final advance.

The record of ice-sheet fluctuations in the British Isles (and in northwest Europe in general) can be linked closely to fluctuations of sea-surface temperature, apparently driven by changes in the circulation of the North Atlantic. The Sierra Nevada glacial chronology can similarly be related to changes in the California Current, but in fact, the similarities to the North Atlantic paleoceanographic record are closer than those to the California Current. The remarkable similarity in the high-frequency fluctuations of the ice bodies in these two distant locations strongly suggests that both were governed by hemispheric-scale (and possibly global) fluctuations in temperature. Although variations in the strength of the North Atlantic circulation can explain rapid temperature fluctuations in northwest Europe, this mechanism cannot be extended to western North America. Changes in atmospheric CO_2 concentration would have a global impact, but the observed glacial fluctuations appear to be too rapid for this causation to be plausible. The rapidity of the teleconnections appears to require an atmospheric linkage, but its nature remains obscure.

Salinization of the Rio Grande: Young water, old salts?

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Although attention is more frequently devoted to inadequate quantity of water of water in arid regions than to quality, in many cases the degradation of water quality "consumes" amounts of water comparable to actual use. The Rio Grande in the western United States suffers from this process. The total dissolved solids content (TDS) of the river water increases from ~50 mg/L in the headwaters to 1500 to 2500 mg/L south of El Paso, a flow distance of ~1200 km. This progressive degradation of the river quality has generally been attributed to successive re-use of the water, with salts being continually concentrated by repeated cycles of evapotranspiration.

We have applied a suite of environmental tracers to investigate the hypothesis that groundwater-surface water interaction may play an important role in the river salinization. By focusing on dating salts and "fingerprinting" sources of salinity using conservative environmental tracers, the complexities of reactive chemistry can be reduced, allowing simplified mass balances to be solved. Suitable tracers include the Cl/Br ratio, the $^{36}Cl/Cl$ ratio, B and Li (and possibly the stable isotope ratios of these elements), the $^{87}Sr/^{86}Sr$ ratio, and $\delta^{18}O$ and $\delta^{2}H$in the water. Our results indicate that although most of the water flowing down the river may be "young" (averaging a few years), most of the salts are "old" (hundreds of thousands to millions of years). Conservative solutes increase in a step-wise fashion down the river. The points of rapid increase generally coincide with the downstream terminations of the individual sedimentary basins comprising the Rio Grande rift. The isotopic and geochemical fingerprints of the added salt are typical of old, saline, groundwater, not evapotranspiration of meteoric water. The identification of potential, discrete, sources of salinization raises the possibility of practical measures to intercept the saline water and improve the quality of the river.