PAST CHANGES OF THE ANTARCTIC ICE SHEET IN TERRE ADÉLIE AS DEDUCED FROM ICE-CORE DATA AND ICE MODELLING

(Abstract)

by

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An ice core drilled at D10 (66°42'S 139°49'E) 5 km inland from the Terre Adélie coast, Antarctica, has been analyzed for stable isotopes, total gas content, aluminium and microparticle concentration. The isotope and gas-content records are interpreted in terms of past elevation changes in the interior of Antarctica. The extent, magnitude and timing of the changes is determined by modelling the ice flow along an International Antarctic Glaciological Project (IAGP) flowline passing through D10. A chronology is established for D10, by comparing the isotope, aluminium and microparticle records with those from an ice core drilled at Dome C (74°42'S 124°04'E) near the summit of the flowline, on the high East Antarctic plateau. A chronology for the Dome C core is given by Lorius and others (1979) and refined by Lorius and others (1984). A preliminary interpretation of the D10 record was made by Raynaud and others (1979) in terms of temperature and elevation of origin of the ice but without the benefit of a defined chronology.

The ice flow was modelled, in the first instance, taking into account the present distributions along the flowline of surface elevation, ice thickness, surface temperature, accumulation rate and ice velocity. Where the input data are not well known, the model has been tuned to give a chronology at D10 which matches the dated events in the core record. The model was additionally constrained by relating the measured sodium concentrations in the core with present concentrations at the surface at distances inland.

The modelled trajectory of an ice particle following the flow of the ice from its deposition at the surface to its intersection with the drill hole gives the connection between the surface and ice-core records. Using this connection, modelled profiles of stable isotopes and gas content are produced for D10. The difference between the modelled and measured profiles gives a measure of past changes at times and distances inland corresponding to the depth in the core at D10 of the analyzed sample.

It is found that the surface of the ice sheet inland of 250 km from D10 was between 200 and 400 m higher before 10 ka BP. The ice sheet had reached its present elevation at a distance of 200 km inland by about 7 ka BP. Because data from only one ice core have been interpreted it is not possible to reconstruct a history of changes for an inland site but provide only a "snapshot" at each location for a corresponding time. The results are consistent with the preliminary analysis of Raynaud and others (1979). This work corrects some of the earlier assumptions and chronology. It is notable that the large elevation changes occur after the large isotope change between 15 and 13 ka BP.

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