IMPLICATIONS FOR THE LATE WISCONSIN-HOLOCENE EXTENT OF THE WEST ANTARCTIC ICE SHEET FROM REGIONAL FREE-AIR GRAVITY ANOMALIES IN THE ROSS EMBAYMENT

(Abstract only)

by

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ABSTRACT

Gravity data from cruises 32, 51, and 52 of the USNS Eltanin (Hayes and Davey 1975), approximately adjusted to the new gravity datum (IGSN 71) and reference system (GRS 67), have been used to extend the Ross Ice Shelf gravity map to the edge of the Ross Sea continental shelf. Various regional gravity anomaly fields obtained by applying low-pass filters to these data are strongly negative over the entire Ross embayment; values increase gradually from approximately -300 gu (-30 mgal) near the Siple Coast to -150 gu (-15 mgal) near the edge of the Ross Sea continental shelf.

Comparison of the regional gravity-anomaly fields measured at the surface with the low-order terms of the Goddard Earth Model (GEM) series of satellite-derived gravity fields shows close agreement near the edge of the Ross Sea continental shelf, and a departure of the surface gravity field from the regional satellite-determined field that becomes increasingly negative in a grid-northerly direction. We assume the deviation to be the result of crustal depression remaining from former ice loading, and calculate that a crustal depression of 0 to 190 m remains along a grid-south-east to north-west transect through the Ross embayment.

An estimated 50 to 170 m of crustal uplift remains unadjusted in the grid-western part of the present Ross Ice Shelf, assuming a particular initial ice load at 18 ka BP (CLIMAP) and a simple exponential model of crustal uplift. The approximate agreement between the two methods has encouraged us to use the crustal up-lift estimated from the gravity field and a simple exponential model of crustal rebound to test models of past ice loading and retreat models. Preliminary results show agreement with the CLIMAP reconstruction of the 18 ka BP West Antarctic ice sheet and a retreat model similar to that of Thomas and Bentley (1978).

REFERENCES

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A PRELIMINARY MODEL OF HOLOCENE RETREAT AND THINNING OF ICE STREAM E, WEST ANTARCTICA

(Abstract only)

by

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ABSTRACT

A preliminary numerical model of ice-stream grounding-line retreat and thinning as a function of eustatic sea-level rise has been developed. Grounding-line retreat is computed using the methods of Thomas and Bentley (1978). The change in thickness along the ice-stream profile is found by solving the equation of continuity in two dimensions during the time intervals corresponding to increments of grounding-line retreat. The model was applied to ice stream E, West Antarctica, assuming that the ice stream was initially grounded to the edge of the Ross Sea continental shelf.

Grounding-line retreat was found to begin 12 ka BP after 40 m of eustatic sea-level rise, then to accelerate and proceed rapidly. The grounding line attained its present position by 9.44 ka BP, and retreat continued so that the grounding line was 200 km up-glacier from its present position by 8.75 ka BP, after 90 m of eustatic sea-level rise. About 700 m of thinning occurred on the upper flow line during the 2.56 ka required for the grounding line to retreat to its present position.

The model is preliminary, so it is not justifiable to conclude that the grounding line of ice stream E is unstable. Also, field evidence from the Ross Ice Shelf Geophysical and Glaciological Survey (Thomas and MacAyeal submitted for publication) suggests that the grounding line is in fact rather stable. Sea-floor bathymetry maps do not show a sill capable of stabilising the grounding line at its present position, but stability might be caused by Roosevelt Island, which appears to inhibit discharge.

REFERENCES

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https://doi.org/10.3189/S0260305500003050 Published online by Cambridge University Press