LATE-GLACIAL PALAEOGEOGRAPHIC RECONSTRUCTION MODELS FOR NORWEGIAN FJORD AREAS

(Abstract)

by

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Descriptive numerical reconstruction models of former sea-levels and glaciation are presented, together with numerical models of deglaciation chronology. Calculation programs are implemented on a microcomputer and the results are presented as palaeogeographic maps on a colourgraphic rastermonitor. The area of the Oslo fjord and of other fjords in central and northern Norway are used to test the model against results from conventional reconstruction methods. The quality of these models depends on the quality and number of the calibration data and the complexity of the models. Such models have to be flexible in permitting new field information to be added without changing their fundamental characteristics.

The technique of combining simple numerical reconstruction models with modern colourgraphics seems to be a useful way of presenting field information, as it permits easier visualization of complex four-dimensional time/space processes and patterns. This will in turn improve research methods in Quaternary geology.

NUMERICAL RECONSTRUCTION OF FORMER SEA-LEVELS

Simple mathematical trend-parameter models are used to describe the height of a former sea-level above the present sea-level as a function of the space coordinates x,y and the time coordinate t. This function, consisting of a sum of a great number of power terms of x,y,t multiplied with a parameter, can be expressed in a compact way by matrice representation as the product of five matrices

$$z = f(x,y,t) = (x,y).G.(t).E.(x,y)$$

Three of these matrices contain the variables x,y,t and the two others (G and E) contain all the parameters of the model. The parameters are estimated on the basis of certain displacement curves from the test area and from data of raised shorelines representing one well-known sea-level. The fit of parameters and the rigidity of the trend function depend on the quantity of field data and are controlled by the order of the trend function. This in turn determines the number of parameters necessary for the reconstruction.

The test areas convey field data of different character and consequently the quality of the reconstruction is different in these three areas, mainly dependent on the number and quality of the basic field information.

DATING OF THE DEGLACIATION CHRONOLOGY

By establishing a functional description of the sea-level changes, this formula could be used as a simple way of dating deglaciation by dating the corresponding sea-level represented by observed morphological marine limits. The height of the marine limit can be used in the transformed formula $t = g(x,y,z)$ to calculate the age of this particular event. In this way the ages of a great number of marine limits are calculated and these dates represent a network of dates of deglaciation in the test area. An algorithm for an isoline fitting to this network has been constructed giving simulated ice-front positions. This map represents the deglaciation chronology within an area.

CONSTRUCTION OF FORMER ICE-SURFACES

Based on the calculation of these ice-front positions, ice-surface contour maps are calculated by simple iterative methods presented in Hughes (1981). These maps are tested against field observations of plausible ice surfaces.

CONSTRUCTION OF PALAEOGEOGRAPHIC TOPOGRAPHICAL MAPS

The combination of sea-level and ice surface from a given time, together with topographical data, make it possible to construct palaeogeographic topographical maps. Topographical data are taken from a topographical database with a certain elementary resolution. The value of the topographical height within an elementary square compared with calculated sea-level and ice-surface values determines the palaeogeographical status of this particular square. This square is in turn represented by one pitch on the monitor with a colour signature describing this particular palaeogeographic status. The same procedure for all the squares within the area gives the colour value of all the pixels on the monitor and the result represents the calculated palaeogeographic topographical map.

CONCLUSION

Simple numerical reconstruction models combined with modern colourgraphics seem to be a useful way of combining an increasing number of field information and this method permits easier visualization of complex four-dimensional time/space processes and patterns.

REFERENCE

Hughes T J 1981 Numerical reconstruction of paleo-ice sheets. *In* Denton G H, Hughes T J (*eds*) *The last great ice sheets.* New York, John Wiley and Sons: 221-261

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