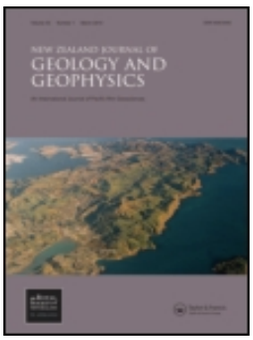

New Zealand Journal of Geology and Geophysics

ISSN: 0028-8306 (Print) 1175-8791 (Online) Journal homepage: https://www.tandfonline.com/loi/tnzg20

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To cite this article: J. C. Schofield (1964) Postglacial sea levels and isostatic uplift, New Zealand Journal of Geology and Geophysics, 7:2, 359-360, DOI: 10.1080/00288306.1964.10420182

To link to this article: https://doi.org/10.1080/00288306.1964.10420182

Published online: 05 Jan 2012.

POSTGLACIAL SEA LEVELS AND ISOSTATIC UPLIFT

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(Received for publication, 19 October 1962; as revised, 5 August 1963)

ABSTRACT

The altitudes of dated raised shorelines in parts of Fennoscandia result from the algebraic sum of isostatic emergence and eustatic submergence. As the isostatic emergence differs systematically from place to place, the eustatic rise can be calculated within narrow limits. Data from New Zealand, some of them new, together with the calculated sea levels with which they are in general agreement, support Fairbridge's recent deduction of a Postglacial sea level higher than the present. In detail, however, Fairbridge's curve of sea-level rise seems to require revision, notably in the elimination of a −15 metre level 9,000 years ago and possibly also of a +3 to +4 metre level, 5,000 years ago.

Acceptance of the calculated sea levels permits computation of the real uplift for localities on the Baltic and Canadian shields. When uplift is plotted against time, the curves obtained for all localities belong to one family, indicating that similar forces were at work at precisely the same times within both shields. This similarity, together with the high rate of uplift, particularly in early Postglacial time, makes it almost certain that isostatic rebound, following melting of the ice, has been real and not illusory.

INTRODUCTION

There have been several recent attempts to produce a curve showing the Postglacial changes in sea level (Shepard and Suess, 1957; Godwin *et al.*, 1958; Fairbridge, 1958 and 1961; McFarlan, 1961). The effects of local earth movements have been recognised as a source or error, but it is hoped ultimately to establish true eustatic fluctuations from which local deviations, due to earth movement, may be distinguished. Because of such movements and because of our imperfect knowledge, there are two main schools of thought—one that considers that sea level has been 5 to 10 ft above the present level during Postglacial time and the other denying this possibility. The latter derives its evidence mainly from the tectonically unstable Mississippi and Dutch coast regions (e.g., McFarlan, 1961; Jelgesma, 1961; Russell, 1963). Both of these regions are known to be subsiding. The most recent proponent of high Postglacial sea level is Fairbridge (1961), who has used world-wide data to produce a Postglacial sea-level curve that shows many fluctuations. Fairbridge, however, did not make a critical assessment of his data and he realised that many were imperfect.

Where land movement has taken place, dated levels can be used for eustatic interpretation only if the amount of movement is known. One such

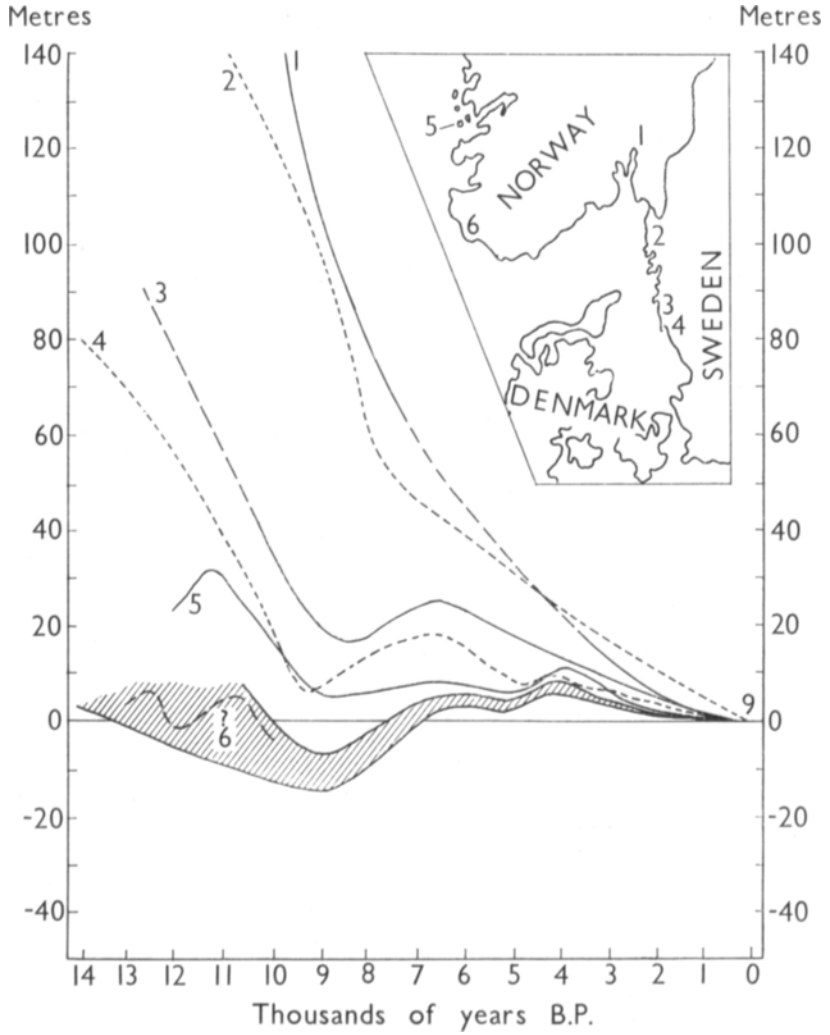

FIG. 1—Curves representing shoreline displacement in areas bordering the North Sea (after Anderson, 1960). Curve 1, Oslo (Hafsten, 1956); 2, Fjällbacka (Hessland, 1946); 3, Göteborg (Sandegren and Johansson, 1931); 4, Onsala (Sandegren, 1952); 5, Bømlo (Faegri, 1944); and 6, Lista (Anderson, 1960). The curve representing the shoreline displacement at Lista probably lies within the hatched area. Note that although time in this figure is mainly based on varve analyses, these have been shown to differ only slightly from radiocarbon dates (cf. Nillson, 1960).