Geophysical Research Abstracts
Vol. 14, EGU2012-3732, 2012
EGU General Assembly 2012

Bayesian modelling of geomorphic time series: collapse of the marine portion of the Irish Sea Ice Stream

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Bayesian modelling offers a methodology for integrating different forms of dating control. Routinely applied to sets of closely spaced, stratigraphically related samples (e.g. radiocarbon ages for lake sediment cores), the method is less widely applied to constrain geomorphic contexts where temporal control is often spatial distributed and from more than one dating technique. Reasoning of the geomorphology can produce relative order models and this prior information can used to constrain the independent probability distribution of each dating sample in a series to restrict the uncertainty ranges for individual ages when overlapping distributions occur. The advantages of this method are the reductions in the uncertainty of age estimates and an analysis of the correspondence between the stratigraphical order and the scientific dating information. The first Bayesian statistical integration of all the dating control (14C, CN and OSL methods) for a sector of former British and Irish Ice Sheet shows an excellent conformable agreement between the chronological measurements and the proposed relative order of expansion and retreat of the Irish Sea Ice Stream. During late Marine Isotope Stage (MIS) 2 the ISIS expanded during a rapid advance southwards ($\sim$75m yr-1) into the Celtic Sea where it then accelerated (>125m yr) across the $\sim$200km between the southeast coast of Ireland and the maximum limit in the central Celtic Sea and reaching the Isles of Scilly at 24-23.3 kyr BP. There followed a rapid collapse, with the ice front migrating northwards covering the 280km between the Scillies and Wexford-Pembroke at around 560m yr-1. Northwards from a line between the Wexford and Pembroke coasts towards northwest Wales the rates of marginal retreat slowed to 100m yr-1, at a point that coincides with the constriction and the sea floor topographic high between Ireland and Wales. North of Anglesey the Irish Sea basin deepens and widens and the ISIS experienced further relatively rapid marginal retreat of 200m yr-1 vacating the north Irish Sea Basin by 21.9-20.7 kyr BP. There is a strong temporal correspondence of factors conducive to the rapid collapse of the marine-fronted ISIS, which can initially be related to rapid sea level rise, but with the combination of rapid climatic warming, reactivation of meridional circulation and megatidal amplitudes forcing the forcing the very rapid collapse of the ISIS. The pattern of ice marginal retreat northwards further supports the oceanic control of the initial collapse, but with the bedrock topography, constrictions between Ireland and Wales, and internal reorganisation of ice flows within the BIIS significant contributors.