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Palaeoceanographic changes reflected by North Icelandic Lateglacial and Holocene shelf records

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A combined study of foraminifera, diatoms and stable isotopes in marine sediments off North Iceland records major changes in sea-surface conditions since about 15,000 cal. years (yr) BP. Results are presented from sediment cores obtained at about 400 m water depth from sedimentary basins on each side of the submarine Kolbeinsey Ridge. The chronology of the sedimentary record is based on tephrochronolgy supported by AMS 14C dates. During the regional deglaciation, the planktonic foraminiferal assemblages are characterised by consistently high percentages of sinistrally coiled Neogloboquadrina pachyderma. However, major environmental variability is reflected by changes in stable isotope values and diatom assemblages. Low Î’18O values indicate a strong freshwater peak as well as brine formation by sea-ice freezing during a pre-BÃ¥lling interval (Greenland Stadial 2), corresponding to the Heinrich 1 event. The benthic foraminifera suggest a strong concurrent subsurface influence of relatively warm and saline Atlantic water, and both the foraminifera and the diatoms suggest mixing of cold and warm water masses. Similar, but weaker environmental signals are observed during the Younger Dryas (Greenland Stadial 1) around the level of the Vedde Ash. Each freshwater peak is succeeded by an interval of severe cooling both at the beginning of the BÃ¥lling-AllerÃ¥d Interstadial (Greenland Interstadial 1) and in the initial part of the Preboreal, presumably associated with the onset of intense deep water formation in the Nordic Seas. This indicates an east-west antiphase relationship in oceanographic conditions across the northern North Atlantic during at least parts of the Lateglacial and early Preboreal. The Holocene and modern current system in the area appears to have been established at around 10,200 cal. yr BP. The Holocene thermal optimum, between 10,200 and about 7000 cal. yr BP, is interrupted by a marked cooling of the surface waters around 8200 cal. yr BP. This cold event is

clearly expressed by a pronounced increase in the percentages of sinistrally coiled N. pachyderma, corresponding to a temperature decrease of about 3Â°C, due to increased influence of the East Greenland and East Icelandic currents from the north. A general cooling in the area is indicated after 7000-6000 cal. yr BP, both by diatom data and by the planktonic foraminiferal data. Minor palaeoceanographic fluctuations are clearly reflected in the upper part of the record, and the Medieval Warm Period and Little Ice Age oscillations show a high degree of correlation with solar insolation. The identification of Lateglacial and Holocene tephra markers from Icelandic source volcanoes in sediment cores from the North Icelandic shelf and the correlation of these with tephra layers in reference soil sections in North Iceland and the GRIP ice core offers reliable dating independent of reservoir age variability in the region. Land-sea correlation of tephra markers, that have been radiocarbon dated with terrestrial material or dated by documentary evidence, does in fact provide a tool for monitoring reservoir age variability in the region. Age models developed for the shelf sediments north of Iceland, based on offshore tephrochronology on one hand and on calibrated AMS 14C dates of marine molluscs on the other, display major deviations, both during the Lateglacial and during the last 4500 years. The inferred temporal variability in the reservoir age of the regional water masses exceeds by far the variability expected from the marine model calculations. The observed reservoir ages are generally considerably higher, by up to 450 years, than the standard model ocean. It is postulated that the intervals with increased and variable marine reservoir age reflect incursions of Polar and Arctic water masses derived from the East Greenland Current to the Iceland Sea and the North Icelandic shelf.