Geophysical Research Abstracts
Vol. 12, EGU2010-5936, 2010
EGU General Assembly 2010
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The Relationship between Palaeoceanographic Changes and Marine Reservoir Age Variability North of Iceland during the Last Millennium

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An investigation of spatial and temporal marine reservoir age changes on the North Icelandic shelf shows that deviations between tephrochronological and radiocarbon based age models for marine sediment cores are related to palaeoceanographic changes in the Iceland Sea. We present data from two high-resolution 1000-year sedimentary records from IMAGES core sites MD99-2273 and MD99-2275, located at 650 m and 470 water depths, respectively. The sedimentary and fossil record is very sensitive to past water mass and climatic changes in this region. It has been demonstrated that the position of the Polar Front across the shelf has been very dynamic through the last millennium.

Tephra markers from Icelandic volcanoes have been identified in the marine records. Correlation of these markers to volcanic eruptions of known age, either from documentary records or terrestrial radiocarbon dates not subject to reservoir effects, makes it possible to construct reliable tephrochronological age-depth models for the marine sediment archives.

The marine reservoir age at the location can be estimated using the tephra-based age models and AMS radiocarbon ages of marine molluscs. The marine reservoir age at the site displays considerable variability through the last 1000 years with an average reservoir age of about 650 years at MD99-2273 and 590 years at site MD99-2275. It is suggested that this variability can be related to a generally high, but fluctuating, inflow of apparently old Polar waters to the area with the East Icelandic Current, competing with the Irminger Current bringing Atlantic water to the area. The modern reservoir age of the Irminger Current water mass is close to 400 years (zero deviation from the global apparent age of sea-water).

The East Icelandic Current is mostly dominated by mixed Arctic and Atlantic water masses from the Nordic Seas, but periodically assumes Polar character incorporating surface water derived from the East Greenland Current. Annual vertical winter mixing of the water masses on the North Icelandic shelf creates a new water mass with surface signatures reaching the sea floor.

It has turned out that the distribution of two benthic foraminiferal indicator species in the cores, one for Polar and Arctic water masses (Islandiella norcrossi) and one for Atlantic Water (Cassidulina neoteretis), as well as a comparison with different proxies for sea-ice cover in the area, shows the presence of increasingly cold Polar and Arctic water masses after AD 1300, i.e. during the Little Ice Age, at both sites, hand in hand with in an increase in the reservoir ages.

There are indications that reservoir age may vary with water depth in the area. Relatively high reservoir ages throughout the last millennium at the deepest core site (MD99-2273) can be attributed to a continuously high influence of apparently old water from the Arctic Ocean at the sea floor. The location of this site to the west of the Kolbeinsey Ridge, which has acted as a submarine barrier throughout the Holocene, may have contributed to a relatively high influence of cold Davis Strait overflow water in this area.