Reviewed research article

Marine climate variability from Arnarfjörður, NW Iceland during the Medieval Warm period and early/middle Little Ice Age

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Abstract — *A high-resolution sedimentary record from the subarctic fjord Arnarfjörður in northwestern Iceland provides information on local changes in sea ice cover and a regional oceanographic climatic signal reflecting changes in the position of the Polar Front that separates the North Atlantic Current and the East Greenland Current. The 520 cm long sediment core spans approximately 2000 years and thus offers a multi-decadal time resolution during the Medieval Warm Period (MWP) and the early to middle part of the Little Ice Age (LIA). Approximately 150 years from the top of the core were lost during coring. The marine climate reconstruction is based on multi-proxy study with focus on benthic foraminiferal fauna allowing down-core bottom water temperature (BWT_{TF}) estimations based on the statistical transfer function approach. This first of the kind study from Arnarfjörður demonstrates significant variability in the benthic foraminiferal fauna dominated by Cibicides lobatulus, Cassidulina reniforme and Elphidium excavatum, BWT_{TF} variations of $\sim$3°C, fluctuating from ca. 1.5$\pm$1.1°C to 4.5$\pm$0.6°C. The data is in harmony with previously reported LIA characteristics from the region, which has been described as a period of high amplitude fluctuations, with non-stable conditions and cold bottom waters.*

INTRODUCTION

The oceanographic system around Iceland, the largest landmass in the northern North Atlantic Ocean, is dominated by the Irminger Current transporting warm (3–8°C) and salty ($\sim$35‰) water from the south (Stefánsson, 1999) and the East Greenland Current, which brings cold and fresh polar water from the north (Figure 1a). These two main water masses are separated by the Polar Front (Valdimarsson and Malmberg, 1999). The position of the front varies over time and shapes the climate of Iceland. The Vestfirðir peninsula, NW-Iceland, is in close proximity to the Polar Front and thus ideal for reconstructing marine climate variability.

The North Atlantic climate is influenced by the North Atlantic Oscillation (NAO), which consists of two opposed pressure centers, one around Iceland and the other around the Azores. An NAO index, based on the difference of normalized sea level pressure (SLP) readings from these two locations, was defined by Hurrell (1995, 1996). Fluctuations in the strength of these features strongly influence the speed and orientation of westerly winds (Hurrell *et al.*, 2003), ultimately affecting temperature and precipitation in the N-Atlantic area. During negative winter NAO the westerly winds are weaker than normal and the pressure difference smaller, resulting in reduced Atlantic Water advection and cold/dry conditions over NW-Europe (Hurrell, 1995). Conversely, during positive winter NAO the increased pressure difference results in stronger winter storms crossing the Atlantic Ocean on a more northerly track, generating warm and wet winters in North Europe.