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Definition of tephra layers in volcanic marine environments using major element geochemistry, grain size, mineralogy, and grain morphology. A case study from the North Icelandic shelf.

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Tephrochronology has proved to be an important tool for chronostratigraphical correlation and dating of Quaternary sediment sequences. In Iceland, a unique opportunity to study tephrochronology/tephrastratigrapy provided by frequent volcanic activity. Eight sediment cores taken in marine sediments north off Iceland have been investigated with the purpose of establishing a tephrochronological framework for the area. About 40 tephra layers in marine sediments on the North Icelandic shelf have been identified. The age of fifteen tephra layers has been established, based on radiocarbon dates from the marine sediments and correlations with terrestrial tephra stratigrapy supported by radiocarbon dates on terrestrial organic material, documentary records and correlations with ice core chronologies. However, the proximity of the coring sites to Iceland results in volcanic provenance of nearly all allochterous sedimentary particles in the shelf sediments, so that the distinction between primary and reworked volcanic particles is critically important.

Several methods have been used to detect and define tephra layers in the sediment cores, such as visual inspection of split cores, magnetic susceptibility, X-ray images, XRF high resolution scanning, mineralogical counts, grain morphology and grain size measurements. The major element geochemistry of the tephras has been determined with microprobe analyses in order to enable correlation to source volcanic systems and the definition of boundaries between primary tephra layers and adjacent tephra-

rich sediment. A database of the morphological properties of tephra shards from the major volcanic systems in Iceland is used to improve the definition of primary marine tephras.

One of the key factors when using tephra as stratigraphical age marker is distinguishing between primary tephra, that represents an instantaneous event, and reworked tephra, that is abundant in environments like on the North Icelandic shelf. Nine tephra layers in marine sediment cores MD992275 and MD992271, spanning the Lateglacial and the Holocene, have been selected to define the boundaries between primary and reworked tephra in the sediment. These tephra layers are the Borrobol Tephra, Vedde-Skógar Tephra, S-Tephra, Saksunarvatn Tephra, Hekla 5 Tephra, Hekla 4 Tephra, Hekla 3 Tephra, Hekla 1104 Tephra and V 1477 Tephra. Mineralogical counts and major element chemistry of grains through the tephra layers and adjacent sediment show that tephra from a given eruption continues to contribute to the sediment for a period of time after the first appearance of the tephra layer. Preliminary results suggest that grain morphology can be used to distinguish between primary and reworked-tephra.

Tephrochronology in marine sediments is not only an excellent tool for dating and correlations. Changes in the reservoir age in the area can be established by comparing an age model based on tephrochronology and an age model based on radiocarbon dates from the marine environment. By establishing a tephrochronological framework, a unique opportunity is provided to date rapid changes seen in various climate proxies from the North Icelandic shelf in a reliable way. This can add to the reliability of correlating marine, terrestrial and ice-core records, and improve the quality of palaeostudies in the region.