Chemical composition of the Western Arctic Ocean sediments: Recommended element abundances and potential reference material

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The Western Arctic Ocean is the major continental margins and deep-sea system of the Earth with weathering and sedimentary characteristics similar to glacial environment. It is characterised by the broadest continental shelves, extreme environment and minimal effect of human activities so that it is much less constrained in comparison to other oceanic regions. Arctic Ocean sediments represent an outstanding archive to investigate global change and high-latitude marine geochemical processes. However, no clear understanding of their element abundances has been achieved yet. In this study, six marine sediments samples have been collected from the Western Arctic Ocean shelves and the Canada Basin, in order to provide a comprehensive representation of Arctic sediments. Samples are homogeneously mixed and analysed by ICP-MS, ICP-ES, INAA and 16 other analytical methods in 14 top geochemical institutes in China to ensure that measurements are reproducible over time and among laboratories. The abundances of 71 components (all the major and trace elements) have been determined through 3128 analyses. Owing to extensive inter-laboratory calibrations and statistical analysis, 64 of 71 elements have the highest possible standards of reliability and reproducibility and can therefore be used as recommended values for Arctic Ocean sediments, while the rest 7 components (Br, I, In, Te, C, CO_2 and H_2O^+) are sufficiently homogeneous and stable to be used as indicative values. The results show that the elemental abundances of the Western Arctic Ocean sediments are controlled by material sources and sedimentary environments which are unique when compared with the upper continental crust or mainland and shallow-sea sediments in China. These element abundances can serve as a recommended guideline for environmental assessment, resource exploration, and global change research. Moreover, it can be used as a potential sediment standard for high-latitude/glacial geochemistry study.

Determination of the Early Palaeozoic Strata in Eastern Heilongjiang Province, NE China: Constraints from Geology and Detrital Zircon U-Pb ages

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It has been a controversial issue whether did the Early Paleozoic strata occur in the Songnen-Zhangguangcailing Massif, NE China. This paper provides the LA-ICP-MS zircon U-Pb dating results from the Chenming Formation in the eastern Heilongjiang Province, NE China. Combined with the formation timing of the overlying strata, it is suggested that an Early Paleozoic strata is firstly determined in the NE China. Most of detrital zircons from the Chenming Formation are euhedral-subhedral in shape and display striped absorption or fine-scale oscillatory growth zoning in CL images, implying their magmatic origin. The others show dark accretionary rim formed by metamorphism. The dating results indicate that the detrital zircons from feldspathic quartz sandstone in the upper part of the Chenming Formation yield age populations of 561 Ma, 621 Ma, 683 Ma, 752 Ma, 803 Ma, 822 Ma, 851 Ma, 900 Ma, 922 Ma, 954 Ma, 1781 Ma, 1865 Ma, and 1933 Ma, suggsting that the sedimentary processes of the Chenming Formation could take place after 561 Ma.

In the study area, the Baoquan Formation occur as overlying strata over the Chenming Formation with the unconformity relationship. The detrital zircons from argillic siltstone in the lower part of the Baoquan Formation yield age populations of 425 Ma, 450 Ma, 485 Ma, 900 Ma, and 1750 Ma (Meng *et al*, 2010) whereas the rhyolite in the upper part of the Baoquan Formation formed in 383 Ma. Taken together, we conclude that the Chenming Formation formed between 561 Ma and 425 Ma, i.e., Early Palaeozoic. Additionally, the age population of detrital zircons from the Chenming Formation reveal that the Neoproterozoic as well as Paleoproterozoic terranes could occur within the Songnen-Zhangguangcailing Massif besides the Paleozoic terranes. Combined with the distribution of geological terranes around the study area, we consider that the provenance of the Chenming Formation mainly come from the Paleozoic igneous rocks and minor Precambrian basement remnant around the study area. This is a firstly discovered Early Palaeozoic strata with the exact geochronological evidence in the eastern Heilongjiang Province, NE China.

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