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Environmental and landscape evolution from Be-10 record in sediments of arid regions (UAE)

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Natural landscape evolution is strongly linked to the climatic and tectonic settings of a region. Consequently, indicators of landscape changes through time can provide vital information on climate and tectonic changes in the past. Be-10 data from arid regions, although challenging due to the difficulties of finding well preserved archives, can contribute to a better understanding of climate change in the past. Here, we have conducted a large-scale sampling of variable sediments (sand dunes, wadi deposits, terraces, alluvial fans, loess and Sabkha) from different environmental and tectonic settings in the UAE (lat. 23˜26o and long. 52˜56o) with the aim of investigating landscape evolution during the Quaternary. In addition to Be-10, we use geomorphic, sedimentologic and tectonic information to provide a picture of the environmental variability in the region. Based on topography, the region was divided into highlands, alluvial plains, sand dunes and coastal Sabkha. Due to the large textural variability of the sediments and to get comparable results, we used a grain size fraction < 200 micrometers for the chemical extraction of Be-10. The AMS analysis of Be-10 was performed in the Tandem Laboratory, Uppsala University. The results of Be-10 indicate a range of 1-33×107 atoms/g with an average of 6.4×107 atoms/g and highest values found in the alluvium deposits of the highlands and the lowest in the sand dunes region. Be-10 of the coastal sediments was rather constant, at a value of 6˜7×107 atoms/g. These results indicate Be-10 concentrations that are lower than what is expected from latitude-zonal models. However, the recent global atmospheric Be-10 production models suggest low production and deposition at low latitudes. The mineralogic difference between the deposits (silicates, carbonate or evaporite) did not show a clear effect on Be-10 values. The low rainfall in the region (50˜250 mm/y) means that most of the Be-10 deposition is related to dry fallout. This is also well illustrated by the higher values in the relatively rainy highlands compared to the rain-poor sand dunes region. These highlands have been subjected to tectonic uplift and sea level changes that have affected erosion and depositional rates. The occurrence of tillite-like deposits and water-ice erosional features in the highland along incised valleys suggest formation of ice bodies (likely small winter glaciers) in this region, which was most likely during the ice ages. The effort to produce carbon-14 dates from the alluvial terraces at the sides of the incised wadies was difficult due to the absence of organic matter. We, however, used carbonate material (stalagmitic and other groundwater drip carbonate forms) collected from a cave in the bedrocks of the area, where the C-14 data indicate infinite ages (older than 40000 years). Although estimating ages based only on 10Be data is problematic, particularly for sediments without other age controls, the 10Be in samples at different stratigraphic levels within the alluvial terraces indicates a range of 1-20×107 atoms/g. The highest concentration is found in the youngest terrace beds, which indicate a large span in Be-10 (likely ages too) that has associated with terraces development in the area. The variability of the Be-10 concentration in the terraces reflects changes in the primary concentrations during deposition, leaching/enrichment in the terrace profile and addition/removal by wind. The 10Be concentration in the modern fluvial sediments of the wadis, sandy-muddy samples of a wadi bed, indicates concentrations of 14˜17×107 atoms/g, which is relatively lower than the highest value in the terrace beds. We are working on linking Be-10 production/depositional models in the region with sedimentation episodes, rainfall rate and erosion rates. The addition of new Be-10 data from arid regions to the global register of soils and sediments is vital for the comprehensive understanding and accurate modeling of Be-10 global deposition and the link to climate change in the past. Göran Possnert has contributed to this project in all its aspects and the authors are honored by his dedication and enthusiasm. He passed away in 2022 and for ethical reasons and scientific

integrity, his name was not included in the authorship list to avoid any possible conflicts during publication.

Student Submission

No

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