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An in situ cosmogenic 14C extraction system at Xi'an AMS Center

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In situ radiocarbon（14C）is produced within minerals at the earth’s surface by a number of spallation reactions. Due to its relatively short half-life of 5730 years, it serves as a unique cosmogenic nuclide tool for the measurement of measuring rapid erosion rates (>10−3 cm yr−1) and events occurring over the past 25,000 years. At Xi'an AMS Center, we have developed and constructed a new vacuum system specifically designed for extracting in situ 14C from quartz samples. Puried quartz samples are degassed and heated to 1600-1650℃ in a high temperature resistance furnace without the use of a fluxing agent. Carbon fraction within the quartz crystal lattice is liberated and oxidized to CO2 in an O2-He mixed atmosphere. The CO2 is subsequently captured through a series of cryogenic traps and hot Ag and Cu wool/mesh, and converted to graphite for accelerator mass spectrometry (AMS) measurement. One major challenge encountered in measuring in situ 14C is establishing a low and reproducible system blank and efficient extraction of the in situ 14C component. Our initial experiments reveal a high blank level and a low extraction efficiency. Through the optimization of the extraction steps, the continuous running of the high temperature furnace and the effective control of all various system components in multiple conditional tests, a lower process background level and stable extraction efficiency are obtained. These results demonstrate that our system is capable of extracting in situ 14C from quartz for surface exposure dating.

Student Submission

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