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^{41}Ca dating marine samples from middle and late Pleistocene

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^{41}Ca (half-life = 99 ka) is a cosmogenic radionuclide that has long been proposed as a promising dating tool for Pleistocene geological sample. However, its practical application has been hindered by two main challenges: 1) its extremely low natural abundance (^{41}Ca/Ca < 10^{-15}) and 2) variable initial ^{41}Ca/Ca ratios. In this study, we applied the advanced Atom Trap Trace Analysis (ATTA) technique to measure ^{41}Ca in seawater samples from all major oceans. Our results indicate that the ^{41}Ca/Ca ratio in seawater is consistent across regions, despite contamination by nuclear fallout in surface waters. Assuming a constant ^{41}Ca/Ca ratio in seawater over time, we applied this value to date calcium-rich marine samples, such as foraminifera and cold-water corals. The ^{41}Ca ages are consistent with nominal ages derived from other dating methods, such as ^{18}O stratigraphy, radiocarbon and U-series dating, with the oldest sample dating to approximately 500 ka. These findings validate the reliability of ^{41}Ca as a dating tool for Pleistocene marine samples.