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Dating carbonate rocks with in-situ produced cosmogenic ^{10}Be: why it often fails

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In-situ produced cosmogenic nuclides have proved to be valuable tools for environmental and Earth sciences. Progress in the field of accelerator mass spectrometry (AMS) allows the determination of radionuclide concentrations as low as of 10^4-10^5 atoms/(g rock) that makes quantifying Earth's surface processes possible.

However, surface exposure dating of carbonate rocks using the cosmogenic radionuclide ^{10}Be is still problematic. In order to investigate the reasons for this, we have performed extensive step-wise leaching of calcite-rich samples. Results on different grain size fractions clearly indicate the sources of atmospheric ^{10}Be being small clay minerals. We demonstrate that partial-leaching procedures that result in moderate pH levels will not release ^{10}Be (cosmogenic or atmospheric) due to the instant re-absorption on grain surfaces. Under strongly acidic conditions absorbed atmospheric ^{10}Be is leached from aluminosilicates giving abnormally high ^{10}Be concentrations and consequently exposure ages that are too old. Dating is only possible if samples do not contain any clay minerals or if they can be removed prior to carbonate dissolution.

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