Calibration of the production rate of ^{36}Cl from potassium

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Production of ^{36}Cl by cosmic ray bombardment of potassium at the earth's surface is higher than from any other target element. Since many rock types contain abundant potassium, an accurate value for the rate of this production is crucial for exposure-age and erosion studies that exploit the *in situ* production of ^{36}Cl in surface rocks. Here, we report a calibration of this rate, or rather rates, because there are separate contributions from spallation, muon capture, and neutron capture.

The calibration strategy was as follows:

a) *Select surfaces of well-known age*. Samples were collected from rock surfaces exposed by the end of the Loch Lomond Readvance glaciation in Scotland 11,600 (±500) years ago.
b) *Select a potassium-rich mineral.* Mineral separates of K-feldspar were extracted from the sandstone or granite samples.
c) *Independently calibrate the production due to neutron capture by chloride.* Chlorine-36 was measured in quartz separates from the same rocks.
d) *Determine separately the production due to muon capture.* A 6m-long depth profile of ^{36}Cl in K-feldspar separates from a granite quarry at Wyangala in SE Australia was measured in order to disentangle the relative contributions from spallation and muon capture.

Samples were prepared as AgCl using standard techniques. Chlorine-36 concentrations were measured by accelerator mass spectrometry using the 14UD accelerator at the Australian National University. From these data, we deduce the following ^{36}Cl production rates from potassium at sea level and high latitude:

Spallation by fast nucleons	161 ± 9 atom $(\mathrm{gK})^{-1}$ yr^{-1}
Capture of negative muons	10.2 ± 1.3 atom $(\mathrm{gK})^{-1}$ yr^{-1}

Characterisation of Sr in coral aragonite by EXAFS

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We have analyzed the aragonite from *Porites lobata, Pavona gigantea, Pavona clavus* and *Montastrea annularis* corals using Sr K-edge Extended Absorption X-ray Fine Structure (EXAFS) and compared these with aragonite, strontianite and mechanically mixed standards. We seek to know the structural sate of Sr in coral aragonite, specifically whether it is entirely substituted for Ca within the aragonite (single-phase), or whether submicroscopic crystals of strontianite are also present in the structure (dual phase), as suggested previously. We performed bulk analyses and compared the data with equivalent μEXAFS analyses on small (~400 μm^3) analytical volumes using a microfocussed x-ray beam. As a result of the architecture of the coral skeleton, the crystals within the microanalytical volume are not randomly oriented, and the microanalytical x-ray absorption spectra show orientational dependence. However, refinement of bulk and microanalytical data provided indistinguishable interatomic distances and thermal vibration parameters in the third shell (indicative of Sr speciation). Analysis in μEXAFS mode allows the structural state of individual parts of the coral skeletal architecture to be ascertained, and the data quality is comparable with bulk analysis. The Sr K-edge EXAFS of all the coral samples refine, within error, to Sr ideally substituted in aragonite, in contrast to previous studies, in which strontianite was reported. Some samples from that study were also analyzed here. Strontianite may be less widely distributed in corals than previously thought. Coral aragonite is a Sr-supersaturated, metastable, single-phase aragonite. These observations have implications for the long-term stability of coral aragonite and the use of Sr in corals to reconstruct past seawater temperatures.