



The cosmic ray flux as relevant to exposure dating

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In the last decade our ability to measure and model the flux and energy spectra of the cosmic rays in the atmosphere has greatly improved. This research was originally triggered by health concerns for pilots and flight attendants, but lastly found its way to help us to improve our understanding of the cosmic ray flux as relevant to exposure dating. This came at a useful time, since the international CRONUS projects that were aiming at a geological calibration/verification of the cosmic ray flux models (i.e. scaling factors) came to a conclusion in the same period. As result of the joint exercise an entire suite of scaling factors, i.e. those based on neutron monitors similar to those used at observatories, were abandoned because of their failure at accurately describing changes in the cosmic ray flux at high altitude (>3000 m). This failure is probably due to the observatory monitors' propensity for multiplicity (counting one event as several events) when interacting with high-energy particles, which become increasingly abundant at high altitude.

Survivors of the geological verification exercise are one legacy scaling method and a scaling method relying on the new measurements/models of cosmic ray flux and energy spectra in the atmosphere; the latter has since been joined by at least another. While the performance of the 'survivors' is similar in the altitude and latitude range covered by the verification exercise, they do not provide the same answers in all areas. Differences are largest (10-20%) between sea-level and 1000 m altitude at latitudes between 20° and 40°. Consequently the different scaling methods, legacy and new, cannot be considered as being equivalent. The aforementioned improvements in our understanding of the neutron flux and its measurement/modelling and revisiting original data sources are used to elucidate reasons for these differences and their consequences for exposure dating.