Contribution ID: **2** Type: **Presentation**

Cosmogenic dating of the critical zone and climatically influenced denudation rates of the southern African plateau

Wednesday, 14 August 2013 15:30 (1h 30m)

Cosmogenic nuclides are produced through the interaction of high-energy cosmic ray particles with target nuclei in the earth's atmosphere, in meteorites and in terrestrial rocks. Because cosmic ray particles interact with the earth's atmosphere during their descent, cosmogenic nuclides produced in situ in terrestrial surface rocks are several orders of magnitude less abundant than in meteorites, and thus it is only in the last two decades that technological advances have allowed for their routine analysis. Cosmogenic nuclides typically yield constraints on earth surface exposure histories on an intermediate timescale of 103 to 106 years and are thus useful for the investigation of a range of geomorphological problems. Southern Africa offers a unique field laboratory for such research, as it paradoxically exhibits tectonic stability and low rates of denudation despite its high topography.

Here we examine the present controls on denudation in southern Africa through an investigation of the maximum denudation rates of Karoo dolerite surfaces in the region, determined from the abundances of cosmogenic noble gas nuclides (3He, 21Ne and 38Ar) in pyroxenes. We compare these results with the predictions of a climate-dependent weathering rate model, and find an excellent agreement in the value ranges of both datasets (˜4 m/Myr), which we interpret as evidence that present denudation in southern Africa is weathering-limited and climatically influenced due to an apparent absence of significant regional neotectonic uplift. The onset of this geodynamic coupling is unknown but may be of considerable antiquity, thus allowing for the prolonged tenure of southern Africa's inherited Cretaceous topography. We also compare these low bedrock denudation rates, which may be interpreted to represent local rates of soil production, with various literature estimates for the corresponding rates of soil erosion in the same catchments, and find that they are in all instances lower, by up to two orders of magnitude. This significant contrast between long term rates of climatically-influenced soil production and short term rates of anthropogenically-driven soil erosion suggests that current agricultural practices are unsustainable under prevailing geological conditions.

Primary author: Prof. DE WIT, Maarten (Chair: Earth Stewardship Science - AEON, NMMU)

Co-author: Dr DECKER, John (Principal Geologist, Petroleum Agency SA)

Presenter: Prof. DE WIT, Maarten (Chair: Earth Stewardship Science - AEON, NMMU)

Track Classification: Workshop Programme