3 ACCELERATOR MASS STECTROMETRY

The Accelerator Mass Spectrometry (AMS) research group is based at the TAMS department's 6MV tandem accelerator. AMS is about studying long-lived radioisotopes and their applications, and we have now capabilities for studying radiocarbon and two further isotopes produced on Earth by cosmic rays, Beryllium-10 and Aluminium-26. AMS projects cover a wide range of disciplines, however our two focus research-areas are paleoscience/heritage studies and geology/environmental studies, aligning with significant research priorities for South Africa.

Highlights for radiocarbon dating include our southern African tree project for climate studies (first outcomes reported in Nature Plants), a study on the Great Zimbabwe site – where we doubled the number of existing age determinations, and a study of pine beetle cycles and forest damage in North America over the past centuries, with a focus on the Mt. St. Helens (US-WA) area. The latter study also yields fresh data on the occurrence and frequency of past eruptions of that volcano. We are further exploring a new ecological application employing the ^{14}C bomb-pulse to date the age of long-lived animals for population studies, specifically this year we looked at the dating of claws from wild-caught crocodiles. In summary over 450 AMS results have been processed and handed over after radiocarbon analysis, divided over 11 sample wheels and 8 beam-time sessions of up to one week each.

The most significant outputs in the past year were a publication on "The demise of the largest and oldest African baobabs" (Adrian Patrut et al., Nature Plants, Volume 4:423-426, 2018), which very significantly relies on Dr Stephan Woodborne's work on Baobab trees in southern Africa, and a publication on "Limits on supernova-associated $^{60}Fe/^{26}Al$ nucleosynthesis ratios from accelerator mass spectrometry measurements of deep-sea sediments" (Jenny Feige et al., Physical Review Letters 121:221103, 2018) one of the results of a multi-year international collaboration for finding supernova deposited radioisotopes on Earth. The paper on baobabs had particular news-value, ranking 66 globally for 2018 (https://www.altmetric.com/top100/2018), and the supernova publication drew an editor's recommendation within Physical Review Letters.

Figure 12: The enigmatic baobab of southern Africa. We study its growth, its death, and as an archive for climate data of a more distant past.