The history of aridity in Australia

John Chappell\textsuperscript{1}, Ed Rhodes\textsuperscript{1}, Brad Pillans\textsuperscript{1}, Toshiyuki Fujioka\textsuperscript{1}, Masahiko Honda\textsuperscript{1}, John Magee\textsuperscript{1} and Kath Fitzsimmons\textsuperscript{2}

\textsuperscript{1}Research School of earth Sciences, The Australian National University, Australia
\textsuperscript{2}Department of Earth and Marine Sciences, The Australian National University, Australia

Australia became progressively drier while it drifted northwards in the Cenozoic but the picture is complex and wet periods punctuated the drying trend. Regolith, groundwater and salts actively interact with the landscape and with each other, during these climatic changes. The project is a study of Upper Cenozoic climate changes in the Australian interior and their effects on the regolith. Targets include aeolian landscapes (longitudinal dunefields, source-bordering dunes and lunettes), stony desert and dissected silcrete and ferricrete landforms, surfaces with thick regolith and deep weathering with mine-pit access, and palaeochannel systems.

The broad timing of major phases of silcrete and ferricrete formation followed by landscape dissection and falling groundwater have been established by palaeomagnetic dating of ferruginous regolith dating of relict fluvial deposits. A key study concerns the age structure of major dunefields and stony deserts, which are the most widespread regolith materials in the arid zone. The ages of other arid-climate deposits including aeolian silt mantles are also being determined.

Stony deserts are durable indicators of aridity but hitherto have not been directly dated. We have successfully determined the age of the stony deserts, using $^{21}$Ne and $^{10}$Be produced in surface rocks by cosmic rays, and have shown that Australian stony deserts formed 2–4 Ma ago, at the time when global cooling initiated the Quaternary ice ages and intensified aridity induced major landscape changes in central Australia. To achieve this, we developed new methods for determining cosmogenic $^{21}$Ne in the presence of neon components from other sources. Using our cosmogenic toolkit ($^{21}$Ne, $^{10}$Be and $^{26}$Al), we have also found that the Simpson Desert dunefield has existed for at least the last 1.5 Ma, whereas optical dating (OSL) of drill-core samples shows that individual dunes were active during global cold episodes of the Late Pleistocene ice ages, when many dunes were extensively reworked. In short, the cosmogenic data have allowed us to determine the antiquity of Australia’s most characteristic arid landforms, while OSL dating allows us to assess the degree to which arid landscape processes have been episodic.
Figure 2 History of aridity: sampling site for cosmogenic determination of stony desert ages
Figure 3. Timing of the formation of stony “gibber” pavements in central Australia