Figure 2 | Excavation at Madjedbebe, Australia. During the excavation in 2015, many artefacts were found in the oldest layer of the site associated with human occupation.

Stone Age technology, accomplished all but the final leaps in the most far-flung global explorations, and in one particularly spectacular journey, they must have built ocean-worthy vessels and sailed to Australia. The timing of that jump to the 'land down under' has been an ongoing focus of debate, with some researchers concluding that it occurred no earlier than around 45,000 years ago[3].

Palaeoanthropologists have thought that, by 45,000 years ago, humans had dispersed to opposite sides of the world, reaching both Europe and Australia. But anyone familiar with the main methods of archaeological dating that are used to reach such conclusions might be sceptical, given that the maximum age for which radiocarbon dating can provide accurate and precise results is for dates around 40,000 to 45,000 years ago. Pointing confidently to a maximum age of 45,000 years, when relying on radiocarbon dating alone, could therefore be a form of confirmation bias.

Fortunately, geochronologists have been hard at work, driven by the possibility of developing techniques to answer questions that are beyond the reach of radiocarbon approaches. One of the most productive such techniques is known as optically stimulated luminescence (OSL), which is applied to mineral grains such as quartz. OSL can establish the age of sediments by determining when light last irradiated a mineral grain[4], and provides a way of estimating how long a sample has been buried (Fig. 1). When the conditions are right, OSL-based analysis can give reliable information on more-ancient time frames than is possible by radiocarbon dating.

Armed with OSL technology, Clarkson and colleagues visited Madjedbebe, one of the most debated archaeological sites in Australia. Formerly known as Malakunanja II, it had been excavated on two previous occasions[5,6]. Clarkson and colleagues re-excavated the site (Fig. 2) using high-resolution field techniques and survey instruments called total stations that allow the direct, accurate measurement of the 3D location of found artefacts. This enabled the team to record the locations of its observations with exceptional precision.

The authors sampled organic material and sediment grains for use in radiocarbon and OSL dating down through the excavated layers, enabling them to compare the results from both techniques and to directly overlap this information about age with the plotted artefacts such as stone tools. Within the time frame for which accurate radiocarbon dating is possible, both sets of results are consistent with each other. However, when the limit for radiocarbon dating was reached, OSL was used to date the older layers, allowing the researchers to determine a date for the earliest human occupation of the site. They then used a Bayesian statistical technique to develop an age model for the site that reduced the impact of the potential imprecision of individual dates and provided estimates of age for undated layers between those they had dated. In this way, Clarkson and colleagues show that human occupation of Australia occurred well before 50,000 years ago (and most probably before 65,000 years ago), and that these early Australians had a full complement of advanced Stone Age technology, as demonstrated by the artefacts found at the site.

The outcomes of scientific debates on the extinctions of large animals (megafauna) remain highly contentious, particularly in relation to Australia. A few years ago, I attended a conference at which there was a fierce discussion about whether humans were the agents of extinction of various Australian megafauna. The fantasy still exists