U-Pb DATING OF ANATASE IN SILCRETE

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Silcrete refers to an indurated regolith material cementing quartz clasts in crystalline and crypto-crystalline quartz or amorphous silica, where induration occurred at or near the surface, due to inputs of silica from weathering, streams and/or ground waters (Young 1985). Silcrete is a widespread regolith material throughout Australia and has been the subject of much work, particularly from the 1960s onwards. There is still much unknown or controversial surrounding the genesis, age and significance of silcrete in the Australian landscape. Genetic models range from evaporative processes acting in arid environments (Stephens 1971, Ollier 1978) to crystallisation in swampy environments (Wopfner 1978).

From stratigraphic and fossil evidence, silcretes have been broadly assigned a Tertiary age throughout much of Australia, and a tentative Jurassic age was proposed for some silcretes in South Australia (Wopfner 1978). In some cases ages have been assigned from K/Ar dated basalts that overlie silcretes, however, there is debate about whether the silcretes formed prior to, or after the eruption of the basalts (Taylor & Smith 1975). Clearly, there is a need to develop a technique for directly dating silcrete; in this study we investigate the application of U-Pb methods to dating anatase (TiO_2) in silcrete samples from far western NSW.

Scanning Electron Microscopy (SEM) shows that anatase in silcrete occurs in many textural and genetic situations. The most common is as authigenic, sub-micron to microcrystalline anatase grains dispersed through silica (microcrystalline quartz grains) as part of the cement (Figure 1a). Larger, detrital anatase grains are found as part of the matrix (grains about 10-15 μm diameter). Anatase also occurs as a grain replacement material, composed of very small, sub-micron, grains clustered in fuzzy conglomerations (Figure 1b), and fracture infill. Another easily identified Ti-oxide phase is detrital rutile. The other major detrital phase is zircon, as generally small grains, around 100x15 μm. The anatase is also present in some silcretes as a cementing agent within geopedal cappings on large clasts.

Of particular interest are geopedal cappings on clasts (Figures 2 and 3), and areas where quartz grains are surrounded by anatase. These are areas where the anatase is clearly a late stage phase, and thus should provide a close estimate of the age of formation of the silcrete. Laser Ablation Inductively Coupled Mass Spectrometry (LA-ICP-MS) results indicate that levels of U increase by up to three orders of magnitude in anatase-rich cement and individual anatase grains relative to the siliceous cement within silcretes (Figure 3). Lead and Th also increase by up to 15 times; all other elements analysed show a corresponding decrease. Currently, more detailed laser spot analyses are being undertaken, to determine the U-Pb systematics of the anatase.

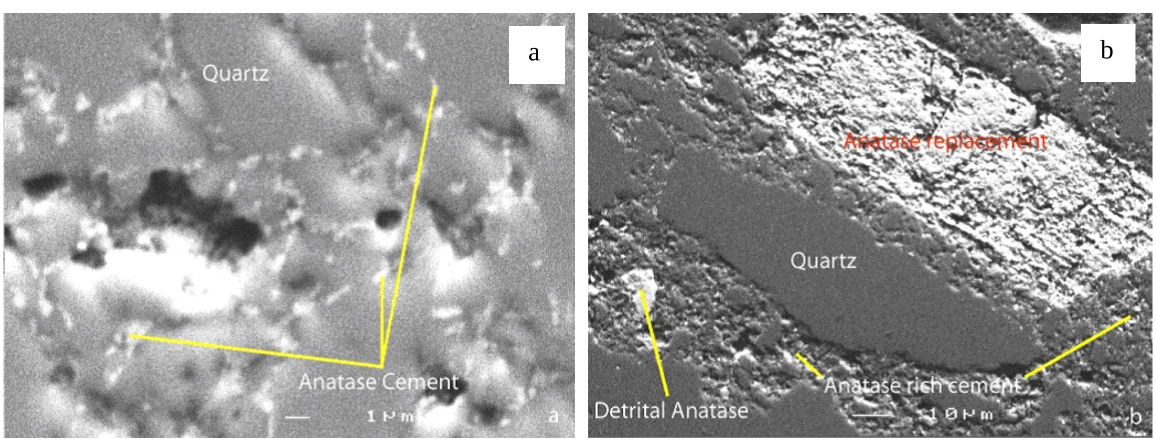

Figure 1: Scanning electron microscope images of anatase in silcrete occuring in different textural and genetic situations: a) cement; b) replacement.

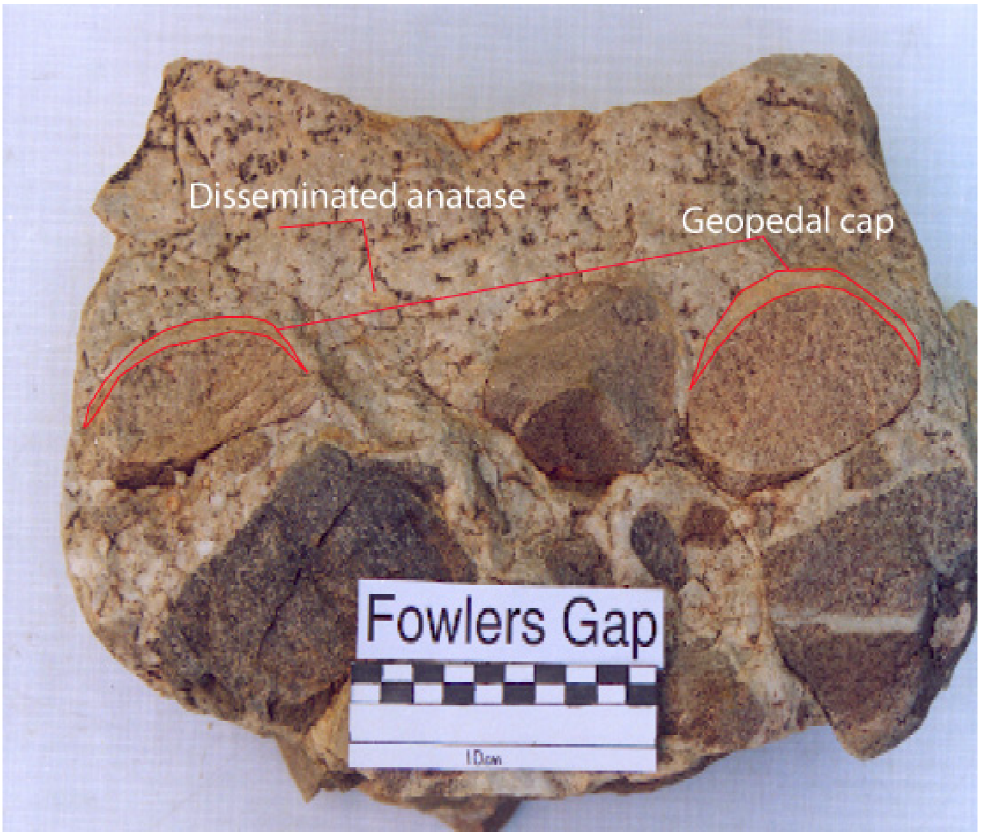

Figure 2: Hand specimen of silcrete from Fowlers Gap (110 km north of Broken Hill), showing distribution of principal anatase phases. This silcrete is estimated to be Eocene in age, based on silicified plant macrofossils (S. Hill *pers. comm.*, Greenwood *et al. 1997*).

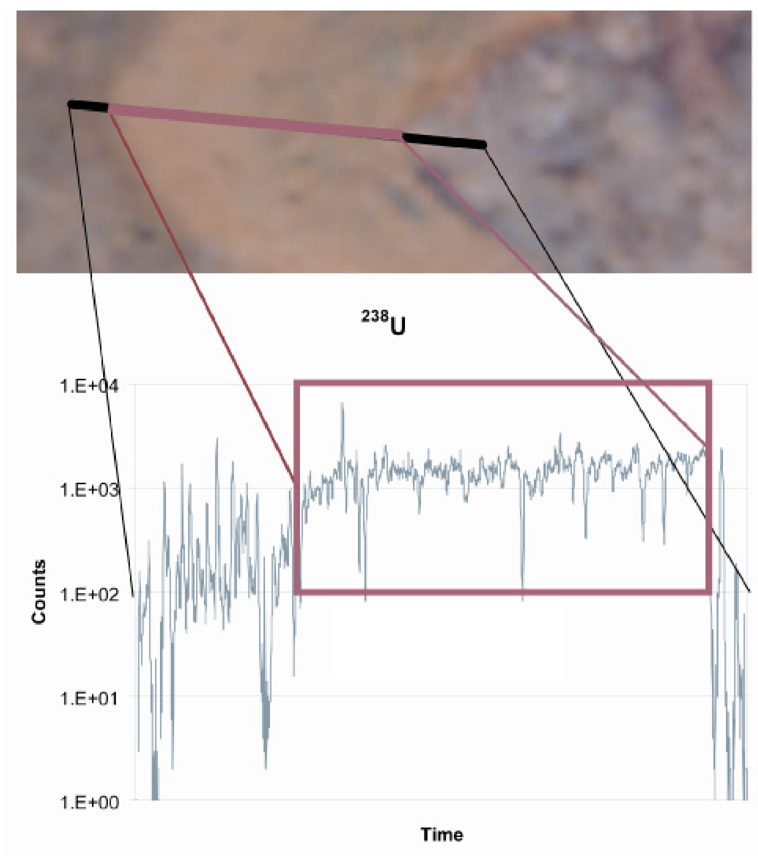

Figure 3: Laser ablation section through anatase-rich geopedal capping.

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