Regolith and spinifex chemistry from the Ngururrpa area, northeastern Western Australia

by

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Introduction

In areas of extensive regolith cover with few bedrock outcrops, detecting the surface location and subsurface orientation of faults usually relies on geophysical and drillhole data. Faults are a key component in mineral exploration in terms of providing both a migratory pathway and focusing mechanism for mineralizing fluids (e.g. McCuaig and Hronsky, 2014). However, even when fault location and morphology are known, whether the fault is a conduit for mineralizing fluids relies on a number of factors, including its age and movement history (e.g. Johnson et al., 2013). The chemistry of the fine fraction of regolith, and spinifex from two transects across a regional fault in a regolith-dominated area of northeastern Western Australia has been used to better constrain the fault position and provide evidence of a fault-controlled fluid. The fine fraction of regolith (in particular the clay fraction) has a propensity to either weakly bond or adsorb ions held in solution, whereas plant roots can take up elements by either cation exchange or diffusion from soil water (Hawkes and Webb, 1962; Dunn, 2007).

Regional geology and sampling transects

The Ngururrpa area of northeastern Western Australia, which is underlain by quartz-rich siliciclastic sedimentary rocks of the Murraba and Canning Basins (Fig. 1), has about 90% regolith cover. The Stansmore Fault bisects the Ngururrpa area, and has a long history of activity, displacing the Proterozoic basement and being periodically active during deposition of Canning Basin sediments. Recent regolith mapping shows possible Cenozoic fault activity. Regolith samples have been collected along two transects across the Stansmore Fault (Fig. 1), and spinifex samples have been collected along one of these transects.

Transect chemistry

The <50 µm fraction of regolith and the ashed component of spinifex were analysed by inductively coupled plasma (ICP) spectrometry following acid digestion.

SRT transect

On this transect (Fig. 1), the Stansmore Fault separates quartz-rich rocks of the Liveringa Group and undivided Mesozoic sedimentary rocks of the Canning Basin. Ten regolith samples were collected along a 3.5 km transect. Sample SRT10, coincident with the Stansmore Fault trace (Fig. 2a), has notably high concentrations of rare earth elements (REE; La and Y) and fluid-mobile elements such as Li, Tl and Cs (not shown), and Zn. Fluid-immobile elements, such as the high field strength elements Nb and Zr, are not unusually enriched in regolith close to the Stansmore Fault, and transect chemistry shows no compositional differences attributable to bedrock.

SR transect

Regolith and spinifex were collected from 12 sites along a 16 km transect across the Stansmore Fault. The transect takes in the Liveringa Group and an upfaulted block of Noonkanbah Formation, bounded to the east by the Stansmore Fault, and to the west by an unnamed fault. Heritage issues prevented collecting regularly spaced samples, including on the inferred trace of the Stansmore Fault. The highest concentrations of La and Y in regolith are in sample SR9, about 900 m east of the inferred Stansmore Fault trace (Fig. 2b). Unlike regolith samples from the SRT transect, fluid-mobile elements in regolith, such as Li, show no positive expression in this sample. However, spinifex from SR9 shows a strong positive response for fluid-mobile elements such as Li and B, as well as Zn and REE. Boron, Li, and Zn also show elevated concentrations in spinifex from SR14, which is coincident with the unnamed fault in the western part of the transect.

Discussion

The behavior of low ionic potential elements such as Li in the fine fraction of regolith (SRT transect) and Li and B in spinifex (SR transect) has the potential to locate fault traces accurately. Both Zn and the REE are less fluid mobile, yet they are in relatively high concentrations in samples of regolith and/or spinifex close to faults. The high concentrations of Zn in spinifex could be explained by preferential uptake, as Zn is an essential element for plant metabolism (Dunn, 2007).

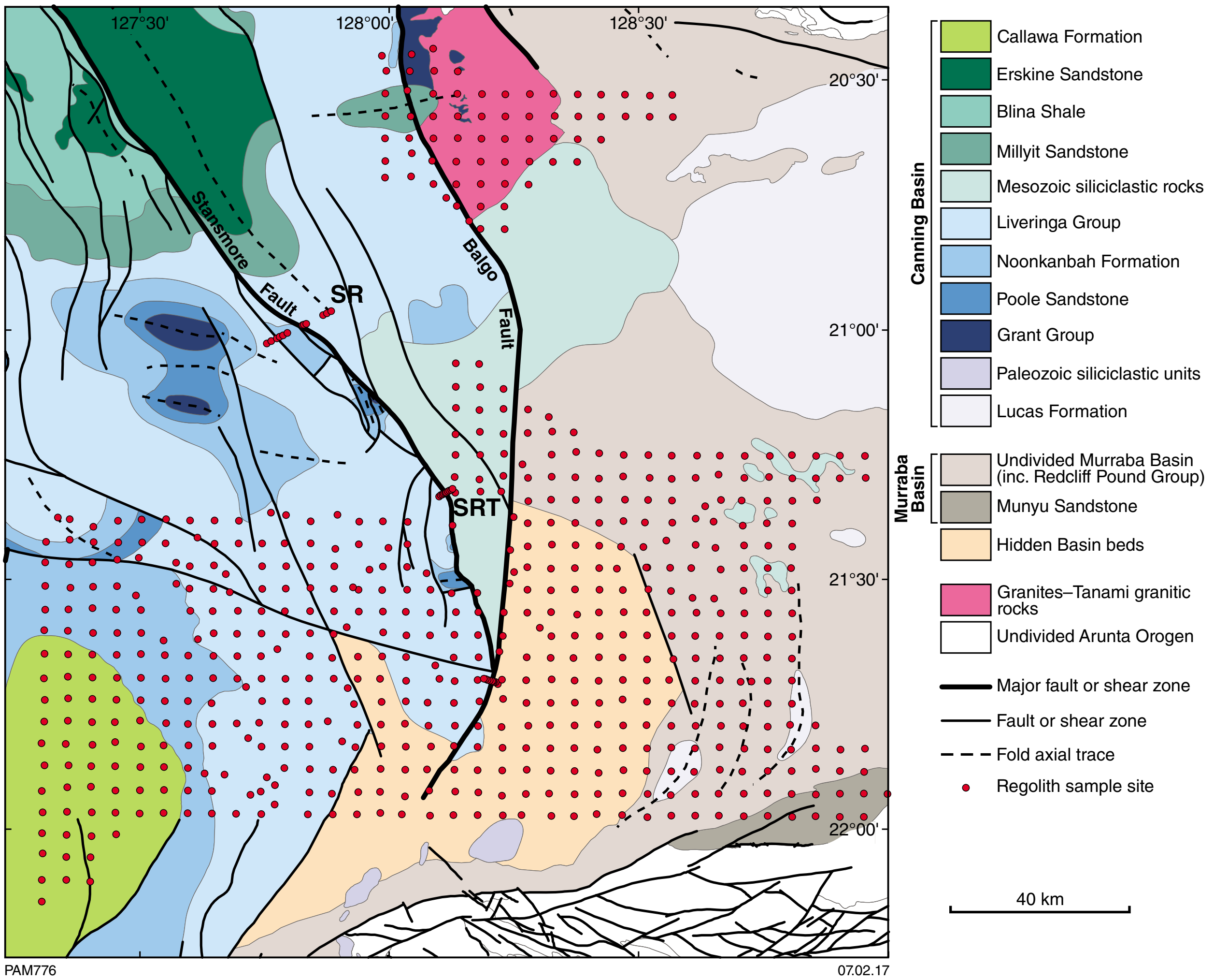

Figure 1. 1:500 000 interpreted bedrock geology (GSWA, 2016) of the Ngururrpa program area, showing the location of the two transects over the Stansmore Fault

However, regolith coincident with the Stansmore Fault on the SRT transect has the highest Zn content from the Ngururrpa program (70 ppm), and it is likely that this is a reflection of the fault-controlled fluid. The REE are not essential for plant health, but are similar to Zn, and sample SRT10 has elevated REE (Fig. 2a), which is also likely to be a characteristic of the fault-controlled fluid.

References

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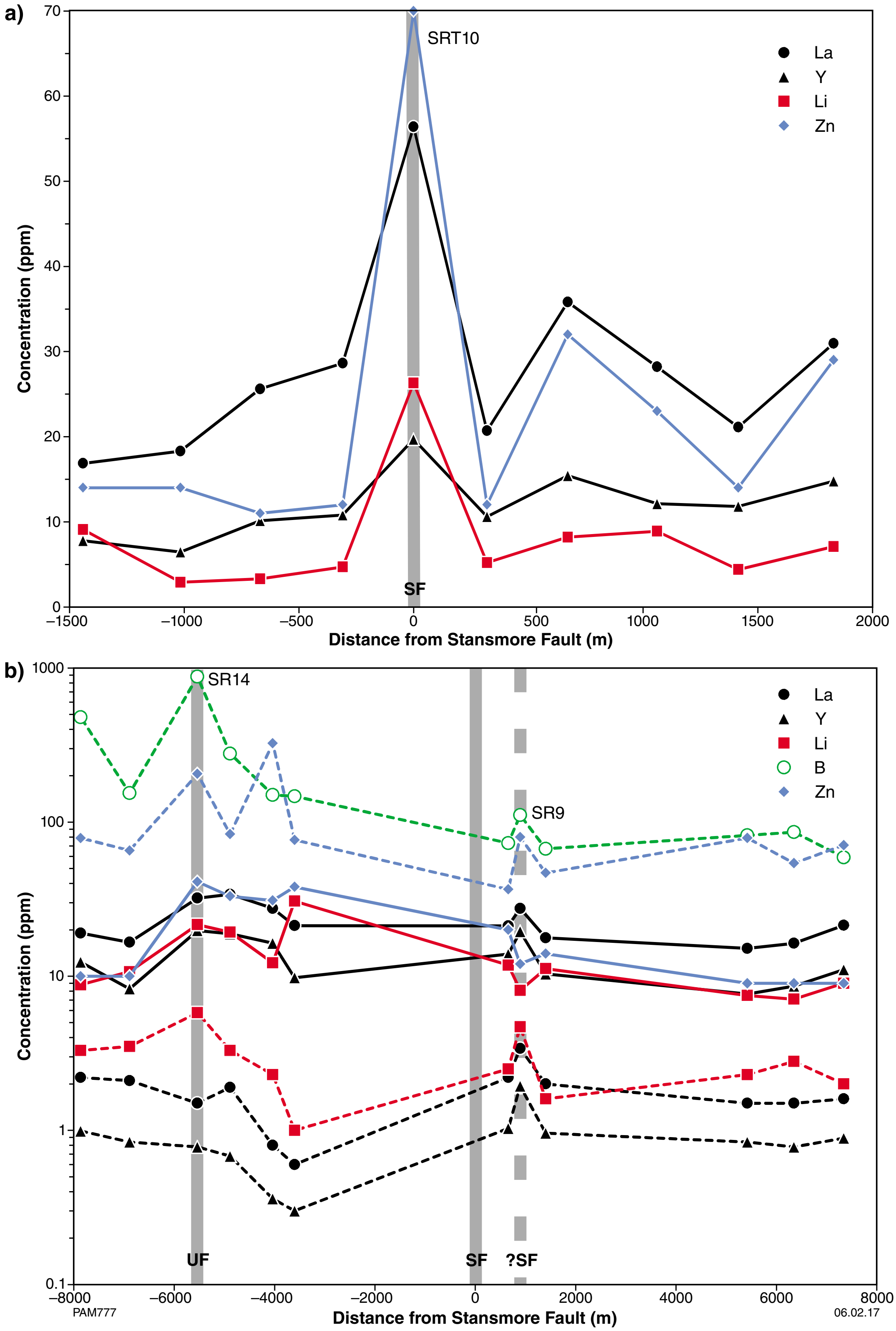

Figure 2. **Chemistry of regolith and/or spinifex samples along two transects over the mapped trace of the Stansmore Fault. All values in ppm. X axis is distance (metres) from the Stansmore Fault (SF). Solid lines – regolith; dotted lines – spinifex. a) SRT transect; b) SR transect. UF is an unnamed fault separating the Liveringa Group and Noonkanbah Formation and ?SF is the possible location of the Stansmore Fault based on regolith and spinifex chemistry. Samples from particular locations on each transect (SRT10, SR9, SR14) are shown.**