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fractionation of sulfur (MIF-S) signatures in Archaean (i.e. older than approximately 2.5 billion years ago) sedimentary rocks3-5 provides a revolutionary way to probe the global sulfur cycle. This study focuses on the Palaeoproterozoic Glenburgh sulfur-bearing gold deposit, which is a ca. 2 billion years old natural laboratory hosted in the Glenburgh arc of Western Australia. Because this arc developed at the margin of a subducting Archaean block, we applied multiple sulfur isotope analysis as a chemically conservative tracer to detect the presence of Archaean MIF-S signatures in the Glenburgh gold deposit. Results show that Archaean sulfur can be traced throughout the Glenburgh arc, supporting the hypothesis that a significant source of sulfur in arc magmas and associated mineral deposits is derived from the breakdown and release of sulfur from sedimentary pyrite in subducting slabs. These findings could revolutionise our understanding of the evolution of the sulfur cycle in the lithosphere and may result in a significant improvement in our understanding of the mobility of volatiles and metals in the outer parts of our planet.

The pre-Andean roots of the North Patagonian Andes: Early Paleozoic low pressure – high temperature metamorphism of the Colohuincul Complex, Argentina

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New mapping and petrological studies conducted on metamorphic rocks of the Colohuincul Complex near San Martin de los Andes (40°S - 71°W) result in the characterization of low pressure–high temperature metamorphism.

The metamorphic rocks are predominantly paragneisses and migmatites with minor schists and amphibolites. The migmatites are mainly diatexites with biotite rich schlieren and schollen of relictic migmatized paragneisses and schists. Leucosomes are equigranular, medium grained and composed of Qtz + Plg + Bt+ K feldspar +Ms. Stromatites are also recognized with leucosomes parallel to S_2 main foliation of paragneisses and schists.

Peak metamorphic assemblage of Qtz + Plg + Bt + Crd + Sill (fibrolite) + K-feldspar ± melt in paragneisess and schists is contained on the S_2 axial-plane foliation. A preliminary P-T pseudosection constructed with Perple_X in the NCKFMASH system allowed us to constrain the peak metamorphic conditions between 560° and 640°C, and below 0.36 GPa.

Field relations indicate that migmatization has occurred within the paragneisses and schists, and was followed by two generations of intrusive rocks: harmonic syn-kinematic leucogranites and discordant post-kinematic tonalitic plutons which cut the metamorphic fabric. The leucogranites are parallel to S_2 foliation and are most likely the result of melt accumulation derived from the anatexis of the local paragneisses and schists. U-Pb SHRIMP zircon crystallization ages of the post kinematic plutons are ca. 390 Ma. The high rheological contrast between this post-kinematic intrusives and their country rocks indicate that the metamorphic rocks were already deformed and metamorphosed at the time of the intrusion. Therefore the metamorphism occurred before 390Ma.

We could identify at least two processes of melt generation. The first and the most important one, is the generation of melt produced by the prograde breakdown reaction of Ms + Qtz. The second one is the leucosome formation due to decompression. After these processes a re-hydration stage is suggested by post-kinematic muscovite porphyroblasts with reaction rims of Ms + Qtz symplectites which overprints the previous metamorphic fabric. Contact metamorphism produced by the intrusion of post-kinematic plutons cannot be completely ruled out as responsible of this porphyroblast.

On a regional context and considering the stratigraphic relations, the HT-LP metamorphism of the Colohuincul Complex on the Northpatagonian Andes seems to be related to an Early Paleozoic subduction zone. In this geotectonic setting, the heat source could be related either to magma intrusions or to underplating of mafic magmas beneath the magmatic arc.

Union Island Group, East Arm basin: A record of continental rifting prior to 1.9 Ga

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The Neoarchean supercontinent Kenorland experienced widespread extension, continental rifting, and enhanced production of continental mafic magmatism in the Paleoproterozoic. During this time the East Arm basin of Great Slave Lake was formed and now preserves a protracted sedimentary and volcanic record along the southeastern margin of the Slave craton. Previous stratigraphic interpretations set the ~1.9 Ga Wilson Island Group as the base of the East Arm basin; however new field observations indicate that the Union Island Group (UIG) is the lowest stratigraphic succession. The UIG is a package of dominantly mafic volcanic and subordinate carbonate/shale sedimentary rocks that were deposited directly on Archean granitic basement, considered to be derived from the Slave craton. Within UIG, two stratigraphically and geochemically distinct volcanic units are recognized: an alkaline to subalkaline basaltic lower assemblage with associated gabbroic feeder sills and dikes, and a subalkaline basaltic upper assemblage. The lower assemblage basalts are geochemically more variable, characterized by high TiO_2 (2.2–3.4 wt%) and Nb (24–62 ppm) contents and more fractionated LREE-enrichment (La/Lu_N=7.6). In contrast, the upper assemblage basalts have a much more restricted composition characterized by lower TiO_2 (1.6–1.7 wt%) and Nb (<4 ppm) contents, with a significant negative Nb–Ta anomaly. The high TiO_2 and Nb contents and low Th/Nb ratio (<0.2) of the lower volcanic assemblage is consistent with an asthenospheric origin with minimal crustal contamination.

We interpret the UIG to represent a pre-1.9 Ga aborted rift sequence that formed under continental extension during the initial formation of the East Arm basin. The results of ongoing tracer isotope and magma evolution modeling investigations will be presented.

Mud Lake dyke (Northwest Territories, Canada) revisited: A mid-Ordovician oxidized dolomite kimberlite

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The Mud Lake dyke located ~45 km SE of Yellowknife is a member of the little-studied group of diamondiferous kimberlites known as Domain I (Heaman et al., 2004, Lithos, 71, 153-184). Virtually nothing was known about the petrography and mineralogy of this dyke prior to the present work. The Mud Lake kimberlite is characterized by macrocrystic and segregation textures comprising macrocrysts of (in order of decreasing abundance): serpentinized olivine, phlogopite, ilmenite, spinel, garnet and zircon in a dolomite-serpentine matrix. In addition to primary dolomite laths, the rocks comprise a variety of secondary carbonates replacing olivine, ilmenite and filling fractures. Other late-stage minerals include serpentine (after olivine), chlorite (after phlogopite), rutile (after ilmenite) and baddeleyite (after zircon). Some samples bear resemblance to dolomite carbonatite from Wekusko Lake (Manitoba), which was initially misclassified as kimberlite. However, both phlogopite and zircon from Mud Lake are distinctly kimberlitic in their trace-element chemistry when compared to carbonatites; i.e. the phlogopite macrocrysts are enriched in Ti, Ni, Cr Co and Rb, but poor in Mn, Sr, Zr and Nb, whereas the zircon contains low levels of rare-earth elements, Th and U, has very low Nb/Ta ratios (1.1 ± 0.1) and shows a strong positive Ce anomaly atypical of carbonatitic zircon.