The geological setting and petrography of the O'Callaghans granite and W skarn mineralization in the Telfer area, Paterson Orogen, Western Australia

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The O'Callaghans granite (OCG) and associated skarn deposit are situated in the Paterson Orogen, Western Australia, about 1300 km north-northeast of Perth. The OCG is part of a series of Neoproterozoic I-type intrusions (e.g., the Mount Crofton, Wilki, Minyari and O'Callaghans granite stocks), surrounding the world-class Telfer Au-Cu deposit. The OCG is overlain by 300-400m of calcareous metasedimentary rocks of the Neoproterozoic Puntapunta Formation. A polymetallic W-Cu-Pb-Zn skarn deposit (78 Mt @ 0.33% WO_3; Newcrest, 2011) occurs in the metasedimentary rocks immediately overlying this granite.

The OCG is a medium grained biotite-monzogranite with accessory titanite, zircon and hornblende. The granite has been affected by two major hydrothermal alteration events: (1) early sericite and chlorite replacing igneous plagioclase and biotite, respectively, (2) late discordant skarn-related quartz±fluorite±pyrite±chalcopyrite±molybdenite±pyrrhotite± scheelite veins up to 1 m wide, surrounded by alkali feldspar-muscovite alteration zones 1-5cm wide.

The exoskarn is defined by amphibole, pyroxene, garnet, biotite, chlorite, and sulfides and related to three major stages: (1) a prograde calc-silicate alteration defined by clinopyroxene, garnet, amphiboles, calcite, quartz, titanite, and accessory pyrite and pyrrhotite, (2) a potassic alteration dominated by biotite, alkali feldspar, muscovite, fluorite, sulfides (pyrite-pyrrhotite-chalcopyrite-sphalerite-scheelite±molybdenite), magnetite, and wolframite, and (3) a retrograde alteration characterized by pyrite, chalcopyrite, chlorite, sericite, and hematite.

Three different fluid inclusion types are present in quartz and fluorite of the potassic alteration stage and crosscutting quartz±fluorite±sulfide veins: (1) aqueous, high salinity inclusions with one or two daughter crystals (e.g. halite), (2) aqueous, low salinity inclusions, and (3) aqueous-carbonic (CO_2±CH_4) inclusions.

The OCG has high SiO_2, Na_2O and K_2O, and low MgO values (Fig. 1A, B, C), as commonly observed in granites associated with W-skarns (Meinert, 1995). The oxidation state of the OCG (Fig. 1D) suggests that the associated W-skarn represents the reduced end member of the W-skarn type (cf. Einaudi et al., 1981; Newberry, 1982).

Further work on mineral geochemistry, fluid inclusions and stable isotopes on skarn minerals will help to better understand the skarn forming processes at O'Callaghans.

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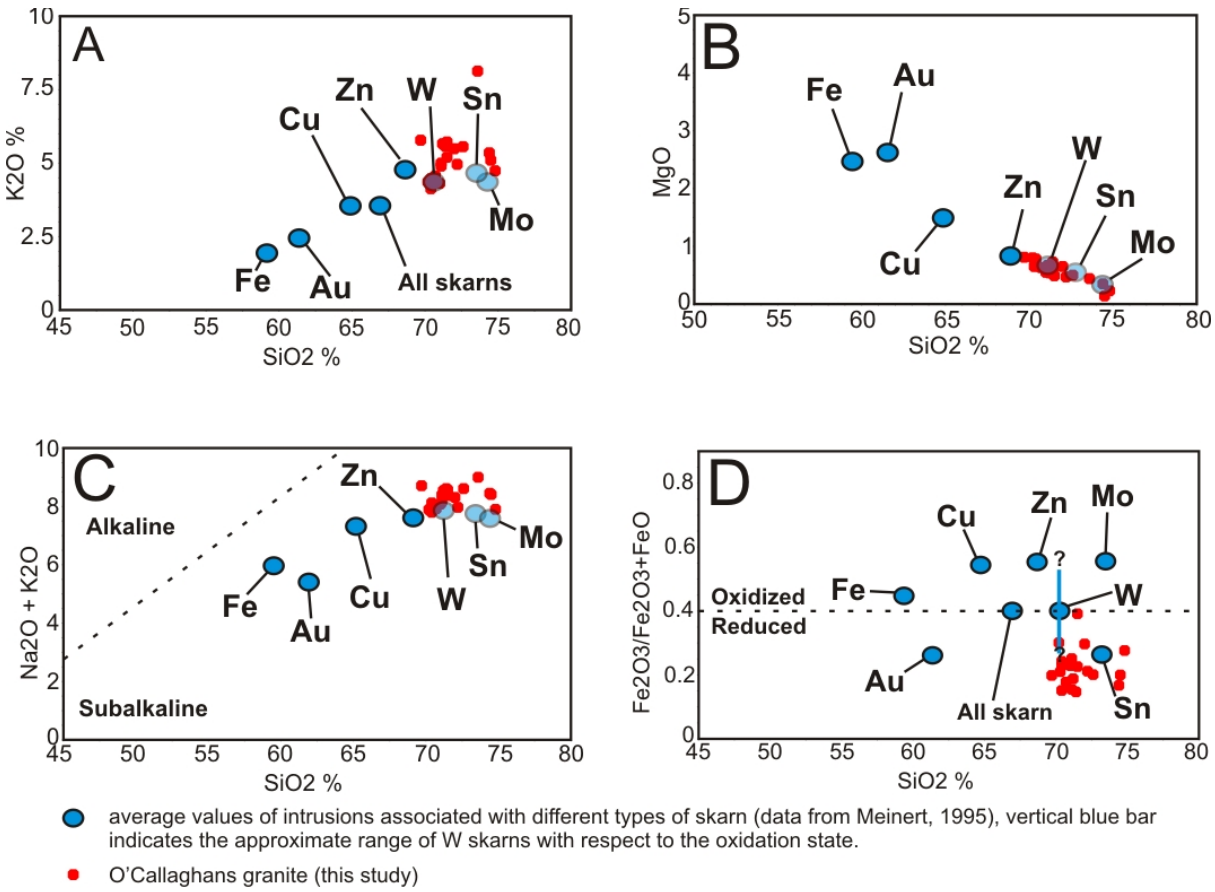

Figure 1: (A) K_2O-SiO_2 diagram, (B) MgO-SiO_2 diagram, (C) Na_2O+K_2O-SiO_2 diagram, (D) Oxidation state of intrusion (Fe2O3/Fe2O3+FeO) – SiO_2;