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The role of volatiles in the genesis of cenozoic magmatism in Northern Victoria Land (NVL), Antarctica

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This study offers an innovative view of the petrogenetic processes responsible for the magmas erupted in the Western Antarctic Rift System (WARS) by studying the chemical composition and the volatiles content of basic lavas and olivine-hosted melt inclusions (MI). Lavas come from three localities: Shield Nunatak (Mt. Melbourne), Eldridge Bluff and Handler Ridge. They are olivine-phyric basanites (42.41-44.80 SiO_2 wt%; 3.11-6.19 Na2O+K2O wt%) and basalts (44.91-48.73 SiO_2 wt%; 2.81-4.55 Na2O+K2O wt%) with minor clinopyroxene and plagioclase. Samples from Handler Ridge clearly differ by having the highest TiO_2 (3.55-3.65 wt%), Rb, Ba, Nb, La, Zr despite their more primitive features (60.83-44.87 Mg#, MgO/(MgO+FeO) %mol). Olivine-hosted melt inclusions (MI) were analyzed for major element and volatiles (H_2O. CO_2, S, F, and Cl) after HT (1300°C) and HP (6 kbar) homogenization. Despite a larger variability, MI are compositionally comparable with the host lavas and are characterized by two distinct trends (high-Fe-Ti-K and low-Fe-Ti-K). The H_2O content in MI ranges from 0.70 wt% to 2.64 wt% and CO_2 from 25 ppm to 341 ppm ($H_2O/CO_2 \sim 1$). At comparable H_2O contents, few samples show a higher CO_2 values (1322 ppm to 3905 ppm) with a H_2O/CO_2 molar ratio down to 0.8. F and Cl content varies from 1386 ppm to 10 ppm and from 1336 ppm to 38 ppm respectively. Concentration of volatiles show a good correlation with alkalies, especially with K2O; Handler Ridge presents the highest total value of F and Cl (2675 ppm). Chondrite-normalized trace elements concentration in MI show an intraplate pattern with negative anomalies in Rb, K, Ti. Accordingly, to the lava contents, MI from Handler Ridge have a significantly higher concentration in Rb (12-45 ppm), Sr (700-834 ppm), Ba (433-554) and Nb (48.8-83.4 ppm) with respect to the other localities at comparable Mg#. Mantle melting mass balance calculations simulate the observed H_2O, CO_2 and Cl concentration by melting a spinel lhezolite from 3 to 7 % of melting (F) with a 5% of modal amphibole with the same composition and modal proportion of mantle xenoliths from Baker Rocks, a locality near to Shield Nunatak. The model was not able to predict the F content which is less abundant in natural sample. From the resulted partial melting percentage, we calculated a total amount of CO_2 in mantle source of 273 ppm by assuming the highest 3900 ppm measured in MI as starting value. The estimated maximum content of H_2O and CO_2 in the primary melt is 2.6 wt% and 8800 ppm respectively. Obtained data were compared with those from mantle xenoliths from NVL with the aim to reconstruct the composition of the mantle source of the Cenozoic magmatism and to model the whole volatile budget from mantle to magmas starting from the measured volatile content in hydrous (amph) and NAM phases in mantle xenoliths. Preliminary results evidence that high-Fe-Ti-K basanites found in MI are very similar to the calculated metasomatic agent involved in the formation of the very peculiar Fe-rich lherzolites.