The correlation between the isotope distribution and geochemistry of mafic to intermediate igneous rocks from the South African West Coast.

L.J. Jordaan *Geological Survey of South Africa, Private Bag X112, Pretoria, 0001.*

R. Scheepers *Department of Geology, Univ. of Stellenbosch, Private Bag X5018, Stellenbosch, 7600.*

E.S. Barton *Bernard Price Institute for Geophysical Research, Univ. of the Witwatersrand, P.O. Box 3, Wits, 2050*

Geological Setting

During the Saldanian orogenic episode (650–500 Ma) a series of rocks, ranging in chemical composition from granite to olivine gabbro (De La Roche *et al.*, 1980), intruded into the older Malmesbury Metasedimentary Sequence (Jordaan, 1990, Gresse and Scheepers 1993). The Cape Granite Suite, incorporating the bulk of the intrusions, is predated by a limited number of small mafic to intermediate igneous bodies. Two of these bodies are situated on the coast, at the town of Yzerfontein and on the farm Mud River. Their main constituents are monzonite and monzogabbro respectively, while younger, more granitic phases are also present. The Yzerfontein monzonite yielded a zircon age of 519 $\pm$ 7 Ma (Jordaan, 1990). A further four bodies are situated 50 km inland near the town of Malmesbury, one consisting of porphyritic granodiorite dykes. The three remaining bodies consist mainly of gabbro and gabbro-norite. The coastal bodies are situated within the Tygerberg tectonic terrain, while the inland bodies are situated within the slightly more tectonized, Swartland tectonic terrain.

Geochemistry

Although all the mafic to intermediate igneous bodies are closely related, a small difference exists between the coastal- and inland bodies in terms of their geochemistry and isotope ratios. This difference in the major element data is mainly due to the K and Na content, as demonstrated on a R1–R2 diagram (Maruéjol *et al.*, 1987), where the inland bodies follow an calcalkaline trend and the coastal bodies follow a high K-calcalkaline trend. Comparison of the data on an AFM-diagram show that the coastal bodies are calcalkaline while the inland bodies are more tholeiitic. On the modified TAS-diagram (Middlemost, 1991), the coastal bodies correspond to a transalkali suite and the inland bodies to a subalkaline suite. A similar division can be made according to the trace elements composition. On a [Ti/100], [Zr], [Y x 3]-ternary diagram (Pearce *et al.*, 1973), data from the coastal bodies correspond to calcalkali basalts, while the inland bodies correspond to ocean floor basalts. The rare earth elements show a further difference between the inland and coastal bodies when compared on a ternary [(La-Sm)-(Gd-Yb)], [Eu], [La-Yb]-diagram (Jordaan, 1990). The Rb and Sr whole rock isotope data show the biggest separation. Inland bodies have a higher initial $^{87}Sr/^{86}Sr$ ratio of 0.70^{87}, compared to the ratio of 0.7047 for the coastal bodies. Within the coastal bodies a further difference exists between the Yzerfontein and Mud River bodies in terms of their $^{87}Rb/^{86}Sr$ ratio. When compared on a conventional ^{206}Pb–^{207}Pb diagram, all whole rock Pb-Pb data plot on a linear trend slightly above the growth curve of Stacey and Kramers (1975). A separation between data from the three different localities occurs within this linear trend. Stable isotope data is only available for the coastal outcrops. The $\delta^{34}S$ values of pyrite from Yzerfontein range from 1 to 2.7‰ while similar pyrite from Mud River range in value from 3.6 to 4.6‰.

Discussion

Although the coastal- and inland groups are related and have historically been treated as one, small differences exist in their major- and trace element compositions, which is also seen in the rare earth element distribution, the Rb and Sr isotopic composition, the Pb isotopic composition and the S isotopic composition. The age as well as the major and trace element composition of the coastal igneous bodies suggest that they are the mafic to intermediate counterparts of the younger

I-type Cape Granites. The inland bodies belong to a tholeiitic series and are possibly the source rocks for the A-type Cape Granites. Rare earth element data supports the distinction made on the basis of major and trace element composition, as it remained unaffected by alteration episodes. Although the Rb and Sr isotope composition have been slightly altered by hydrothermal and deuteric alteration episodes, making age interpretations impossible, the data still remains clustered in distinct groups. This supports the idea that the different intrusive bodies are not genetically identical, possibly due to the incorporation of crustal material. The Pb isotope data which plot above the growth curve again suggest the incorporation of crustal material. The interpretation of the S isotope data from the coastal igneous bodies is restricted by the influence of meteoric fluids during hydrothermal alteration, although a difference still exists between the Yzerfontein and Mud River bodies. The interpretation of the genesis of these mafic to intermediate bodies are therefore not only constrained by the major element composition, which shows the least divergence, but by nearly all geochemical parameters.

References

De La Roche, H., Leterrier, J., Grandclaude, P. and Marchal, M. (1980) *Chem. Geol.* **29**, 183–210.

Gresse, P.G. and Scheepers, R. (1993) *J. Afr. Earth Sci.*, **16**, No.4, 375–93.

Jordaan, L.J. (1990) The geology and geochemistry of mafic and intermediate igneous rocks associated with the Cape granites. M.Sc. Thesis, Univ. Stellenbosch, (Unpubl.)

Maruéjol, P., Cuney, M., Fuzikawa, K., Netto, A.M. and Poty, B. (1987) *Revista Brasileira de Geociências*, **17**, No.4, 578–94.

Middlemost, E.A.K. (1991) *Earth-Science Reviews*, **31**, 73–87.

Pearce, J.A. and Cann, J.R. (1973) *Earth Planet. Sci. Lett.*, **19**, 290–300.

Robinson, B.W. and Kusakabe, M. (1975) *Anal. Chem.*, **47**, 1179–81.

Stacey, J.S. and Kramers, J.D. (1975) *Earth. Planet. Sci. Lett.*, **26**, 207–21