

FERREIRA FILHO, C.F., 1994. The Niquelândia mafic-ultramafic layered intrusion, north-Goiás, Brazil: petrology, age and potential for PGE ore deposits. Unpublished Ph.D. thesis, University of Toronto, 270 p.

FERREIRA FILHO, C.F., KAMO, S., FUCK, R.A., KROGH, T.E. & NALDRETT, A.J., 1994. Zircon and rutile U-Pb geochronology of the Niquelândia layered mafic and ultramafic intrusion, Brazil: constraints for the timing of magmatism and high grade metamorphism. *Precambrian Res.*, 68: 241-255.

FERREIRA FILHO, C.F. & NALDRETT, A.J., 1993. The Niquelândia mafic-ultramafic complex revisited: tectonic setting and potential for PGE deposits. In: I Brazilian PGE Metg., Extended Abst. Vol., p. 25-28.

FERREIRA FILHO, C.F., NALDRETT, A.J. & GORTON, M.P., 1995a. Petrology of the Mesoproterozoic Niquelândia layered mafic-ultramafic complex, central Brazil: evidence for a composite intrusion in an intracontinental rift system. In: ICP 336 "Petrology and Metallogeny of Volcanic and Intrusive Rocks of the Midcontinent Rift System", Duluth-USA, Proceedings, p. 45-46.

FERREIRA FILHO, C.F., NALDRETT, A.J. & GORTON, M.P., submitted. REE and pyroxene compositional variation across the Niquelândia mafic and ultramafic layered intrusion, Brazil: constraints for fractionation models and primary liquid composition. Submitted to *J. Petrology*.

FERREIRA FILHO, C.F., NALDRETT, A.J. & MOHAMMAD, A., 1995b. Distribution of Platinum-Group elements in the Niquelândia layered mafic and ultramafic intrusion, Brazil: implications with regard to exploration. *Can. Mineral.*, 33: 165-184.

FERREIRA FILHO, C.F., NILSON, A.A. & NALDRETT, A.J., 1992. The Niquelândia mafic-ultramafic complex, Goiás, Brazil: a contribution to the ophiolite x stratiform controversy based on new geological and structural data. *Precambrian Res.*, 57: 125-143.

FERREIRA FILHO, C.F., SILVA, C.B. & LOPES, R.O., 1996. Variação críptica em olivina de dunitos do Complexo de Niquelândia, GO. Uma janela para a evolução magnética e saturação de S na Unidade Ultramáfica. In: *Cong. Bras. Geol.*, 39, 03 pp.

GIRARDI, V.A.V., RIVALENTI, G. & SINIGOI, S., 1986. The petrogenesis of the Niquelândia layered basic-ultrabasic complex, central Goiás, Brazil. *J. Petrology*, 27: 715-744.

HOATSON, D.M. & KEAYS, R.R., 1989. Formation of platiniferous sulfide horizons by crystal fractionation and magma mixing in the Munni Munni Layered Intrusion, West Pilbara Block, Western Australia. *Econ. Geol.*, 84: 1775-1804.

NALDRETT, A.J., BRUGMANN, G.E. & WILSON, A.H., 1990. Models for the concentration of PGE in layered intrusions. *Can. Mineral.*, 28: 389-408.

RIVALENTI, G., GIRARDI, V.A.V., SINIGOI, S., ROSSI, A. & SIENA, F. (1982). The Niquelândia mafic-ultramafic complex of central Goiás, Brazil: petrological considerations. *Rev. Bras. Geoc.*, 12: 380-391.

dyne-0906775

## 2 Ga U-Pb (SHRIMP-II) AND Re-Os AGES FOR THE NIQUELÂNDIA BASIC-ULTRABASIC LAYERED INTRUSION, CENTRAL GOIÁS, BRAZIL

Ciro T. Correia<sup>(I)</sup>, Vicente A. V. Girardi<sup>(I)</sup>, David D. Lambert<sup>(II)</sup>, Peter D. Kinny<sup>(III)</sup> and Shane J. Reeves<sup>(IV)</sup>

<sup>(I)</sup> Department of Mineralogy and Petrology, São Paulo University, Caixa Postal 11348, 05422-970, São Paulo-SP, Brazil

<sup>(II)</sup> VIEPS Department of Earth Sciences, Monash University, Clayton, VIC 3168, Australia

<sup>(III)</sup> Department of Applied Physics, Curtin University of Technology, GPO BOX U1987, Perth, WA 6001, Australia

<sup>(IV)</sup> VIEPS School of Earth Sciences, University of Melbourne, Parkville, VIC 3052, Australia

The Niquelândia intrusion is interpreted as an anorogenic, layered, stratiform complex (Girardi et al., 1986). Together with the Cana Brava and Barro Alto intrusions, Niquelândia occurs within a 300 km long, NNE-trending ultramafic belt crossing central Goiás and Tocantins States, Brazil. Rivalenti et al. (1982) divided the complex into five stratigraphic units, from bottom to top: Basal Gabbro Zone (BGZ), Basal Peridotite Zone (BPZ), Layered Ultramafic Zone (LUZ), Layered Gabbro Zone (LGZ), Upper Gabbro-Anorthosite Zone (UGAZ) and Upper Amphibolites (UA). Sm-Nd isotopic data from the Cana Brava complex have yielded a  $1970 \pm 69$  Ma isochron which was interpreted by Fuji (1989) as the time of emplacement. However, conventional U-Pb geochronology of zircons from Niquelândia yielded a lower concordia intercept of 770-795 Ma, consistent with a Brasiliense metamorphic disturbance, and an upper intercept of 1560-1600 Ma (Ferreira Filho et al., 1994). However, these zircons were 70% discordant, suggesting that the upper concordia intercept age is poorly constrained. Thus, there is considerable debate as to the true age of emplacement of these layered intrusions. In order to set better limits on the crystallization age of these intrusions and to trace the source(s) of their parental magmas, we report new SHRIMP-II U-Pb isotopic data for zircons and Carius tube/N-TIMS Re-Os isotopic data for seven whole rock samples from Niquelândia.

The zircons selected for SHRIMP-II analyses include those separated from one highly differentiated gabbro from the top of the LGZ, close to the boundary with the UGAZ (NQ1549). This rock is a medium grained gabbro containing quartz, hornblende, apatite, rutile and zircons. SHRIMP-II data were obtained predominantly from cores of zircons (as determined by SEM cathodoluminescence) but some rims were also analysed. All data from the LGZ gabbro are summarised on Fig. 1. The zircon domains display a large range of U-Pb ages, from  $778 \pm 16$  Ma (very near

Doc. 155

the lower concordia intercept) to  $1991 \pm 49$  Ma (very near the upper concordia intercept), with distinct populations around 780-900 Ma, 1000-1400 Ma and 1600-1880 Ma. We interpret these results to be consistent with a 2 Ga emplacement age for magmas parental to Niquelândia followed by episodic Pb loss as a result of multiple metamorphic events. For instance, metamorphism with Uruaçuano ages (ca. 1.3 Ga) are supported by previous Rb-Sr data (Fuck et al., 1989 and Correia, 1994).

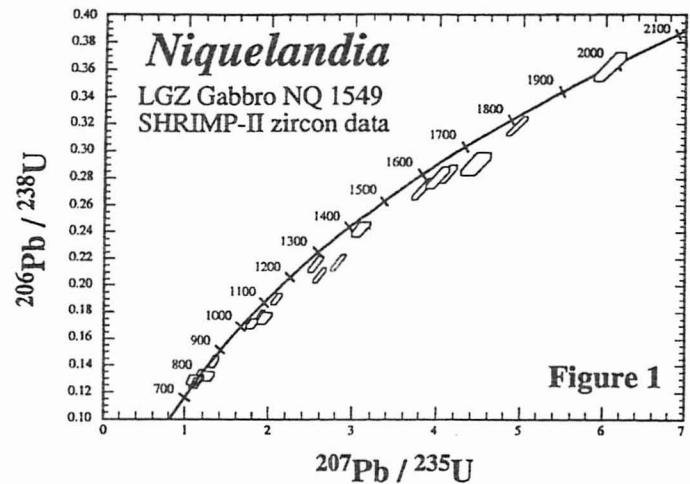
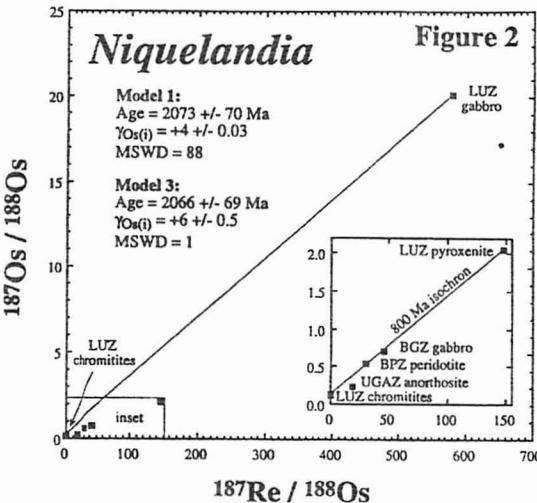


Figure 1

The samples chosen for N-TIMS Re-Os isotopic analysis were: one gabbro from the BGZ; one peridotite from the BPZ; two chromitites, one gabbro and one pyroxenite from the LUZ; and one anorthosite from the UGAZ. On a Re-Os isotopic evolution diagram (Fig. 2), these 7 samples define two preliminary isochrons. One gabbro (LUZ) with an igneous texture and a very high  $^{187}\text{Re}/^{188}\text{Os}$  and the two chromitites with very low  $^{187}\text{Re}/^{188}\text{Os}$  yield an age of  $2070 \pm 70$  Ma and a near-chondritic initial gos value of +4 to +6. This Re-Os isochron age is in close agreement with the oldest SHRIMP-II zircon U-Pb ages from Niquelândia and Sm-Nd isotopic data from Cana Brava, confirming a 2 Ga emplacement age for these intrusions. Moreover, the near-chondritic initial gos value suggests that the parental magmas underwent limited amounts of crustal contamination. Four samples with metamorphic fabrics define a second, much younger isochron (Fig. 2, inset) with an age of ca. 800 Ma. This age is consistent with the youngest zircon ages (this paper-Fig. 1 and Ferreira Filho et al., 1994), confirming a Brasiliano disturbance to the Re-Os isotopic system. These data together support the interpretation that the Niquelândia complex crystallized during the Early Proterozoic (ca. 2.0 Ga) and underwent multiple metamorphic events, the last being during Early Brasiliano (ca. 800 Ma).



REFERENCES

CORREIA, C.T., 1994, Petrologia do Complexo Máfico-Ultramáfico de Cana Brava, GO. Doctorate Thesis, 151 p., Geosciences Institute, São Paulo University.

FERREIRA FILHO, C.F.; KAMO, S.L.; FUCK, R.A.; KROGH, T.E. AND NALDRETT, A.J., 1994, Zircon and rutile U-Pb geochronology of the Niquelândia layered mafic and ultramafic intrusion, Brazil: constraints for the timing of magmatism and high grade metamorphism. *Precambrian Research*, 68:251-255.

FUCK, R.A.; BRITO NEVES, B.B.; CORDANI, U.G. AND KAWASHITA, K., 1979, Geocronologia Rb-Sr no complexo Barro Alto, Goiás: evidência de metamorfismo de alto grau e colisão continental há 1300 Ma no Brasil Central. *Ceochim. Brasil.*, 3(2):125-140.

FUGI, M.Y., 1989, REE geochemistry and Sm-Nd geochronology of the Cana Brava Complex, Brazil. Masters Thesis, 55 p., Kobe Univ., Japan.

GIRARDI, V.A.V.; RIVALENTI, G. AND SINIGOI, S., 1986, The Petrogenesis of the Niquelândia Layered Basic-Ultrabasic Complex, Central Goiás, Brazil. *Journal of Petrology*, 27(3):715-744.

RIVALENTI, G.; GIRARDI, V.A.V.; SINIGOI, S.; ROSSI, A. AND SIENA, F., 1982, The Niquelândia mafic-ultramafic complex of Central Goiás, Brazil: petrological considerations. *Revista Brasileira de Geociências*, 12:380-391.

*This research was supported by the Brazilian Agency FAPESPE (Proj. n° 92/0649-9 and 95/1201-0 and the Australian Research Council (Grant A39131595). Ed Curl is thanked for help with mineral separations. Louise Frick and Jannene McBride for help with Re-Os chemistry.*