



**ECONOMIC GEOLOGY  
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**BIBLIOGRAPHY ON THE GEOLOGY OF  
THE OKIEP COPPER DISTRICT,  
NAMAQUALAND, SOUTH AFRICA, 1685–1990**

**R.H. BOER**

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BIBLIOGRAPHY ON THE GEOLOGY OF THE OKIEP COPPER DISTRICT,  
NAMAQUALAND, SOUTH AFRICA, 1685-1990

by

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## INTRODUCTION

The Okiep Copper District is the oldest mining district in South Africa (Smalberger, 1975). Approximately 1500 intrusives (Marais, 1989, pers. comm.) of mafic rocks of the Koperberg Suite host the copper deposits in the Okiep Copper District which covers an area of approximately 3000 km<sup>2</sup> and is roughly bounded by latitudes 29°25'S, 29°45'S and longitudes 17°30'E, 18°10'E.

The first recorded investigation of copper occurrences in Namaqualand dates back to 1685, 33 years after the establishment of a permanent settlement at the Cape, when Commander Simon van der Stel organized an expedition to the land of the Namaquas to investigate the source of copper ornaments brought to the Castle from that area.

Serious exploitation of the copper deposits commenced in 1852. Initially numerous small companies were active, but eventually control was vested in the Cape Copper Company which managed the Nababeep, Okiep, and Spektakel Mines, and in the Namaqua Copper Company which worked in the Concordia area, north-east of Okiep. The Cape Copper Company terminated its operations in 1919 owing to the post-war economic slump. By 1922 the affairs of the Company were placed in the hands of an official receiver and its property was, for some time, put under option to the General Mining Finance Corporation. When they relinquished their option, the American Metal Company took up the option. In 1928 the South African Copper Mining Company was formed to acquire the assets of the Cape Copper Company. One third interest in this company was held by each of the Newmont Corporation, the American Metal Company and United Verde Extension. The Namaqua Copper Company closed its mines in 1931. In 1936 United Verde Extension pulled out of the South African mining operation and the Newmont Corporation bought their share. Newmont, through successive purchases of stock, had acquired 73% of the holdings in this South African company by 1937. On the 25th May 1937 the O'okiep Copper Company Limited was formed. The Newmont Mining Corporation, American Metal, Rhodesian Anglo American Limited and the International Minerals and Metals Corporation were to bring into production the copper properties in Namaqualand owned by the O'okiep Copper Company Limited. A golden era followed during which investors received dividends totalling R180,3 million as a return on their original investment of R1 021 056 (Marais, 1987). A decline began towards the end of 1974 and ended in 1980, the last time dividends were paid. Instead of copper prices improving to viable levels during the early 80's, they deteriorated. After the second rights offer of shares was made to shareholders, Gold Fields of South Africa was appointed administrative and technical advisers and secretaries to the O'okiep Copper Company Limited from 1 October 1984. Since then the financial position was reversed and by the end of 1986 the Company was able to discharge its indebtedness to the South African Government and raise sufficient working funds through normal commercial financial sources.

This bibliography is a compilation of literature that contributed in a significant way towards the understanding of the copper ores in the Okiep Copper District. Some selected publications on the surrounding geology are included. A vast data set on Okiep geology have been generated by company geologists and recorded in numerous internal company reports. Only a few of these reports are referenced with the permission of Gold Fields of South Africa Ltd. A complete list of Government publications, books, articles and pamphlets on the history and social life in Namaqualand during the early days can be found in Smalberger (1975), Robertson (1968), and Dowdle (1955).

BIBLIOGRAPHY

- Andreoli, M.A.G. (1984). K-REE-P-U-Th-metasomatism in Kibara, charnockite and anorthosite suites of Mozambique, Malawi and South Africa. Proc. 27th Int. Geol. Congr., Moscow, vol. VI, Section 12, 7-8.
- Andreoli, M.A.G., Andersen, N.J.B. and Faurie, J.N. (1986). Anorthosite related polymetallic thorium-uranium deposits in the Namaqualand Metamorphic Complex, South Africa. Ext. Abstr. Tech. Comm. Meeting Geol. Data Integration, Vienna, 1-25.
- Andreoli, M.A.G., Andersen, N.J.B., Raubenheimer, E. and Niemand, N. (1986). Geological map of the Vaalputs National Radioactive Waste Disposal Facility, Northwestern Cape, South Africa (with explanatory notes). Proceedings Volume to the Radwaste '86 Conference, Cape Town.
- Andreoli, M.A.G. and Hart, R.J. (1986). A charnockite-anorthosite related "HIGH-TECH" metal deposit in the Namaqualand Metamorphic Complex. Workshop on metamorphism and metamorphic processes in mineralization, Geol. Dept., Univ. Witwatersrand, Abstr. vol., 4-5.
- Andreoli, M.A.G. and Hart, R.J. (1987). Explosive KREEP-norite from Namaqualand, South Africa, with implications for the Sudbury Irruptive (working paper). Contrib. Int. Workshop on Cryptoexplosions and Catastrophes in the Geological Record. Parys, S.Afr., Sect. A, 1-8.
- Atherstone, G. (1857). Namaqualand and its Mining Prospects. The Eastern Province Monthly Magazine, vol. II no. 13.
- Bain, A.G. (1854). Account of the geology of Namaqualand: Parliamentary report No. A.39. Cape Good Hope, 35-37.
- Bain, A.G. (1857). Geology of South Africa. The Eastern Province Monthly Magazine, vol. I no.8.
- Benedict, P.C., Wiid, D. De N., Cornelissen, A.K. and Staff (1964). Progress report on the geology of the O'okiep Copper District. In: S.H. Haughton, Ed., The geology of some ore deposits in Southern Africa, 2, Geol. Soc. S.Afr., 239-302.
- Benedict, P.C., Wiid, D. De N., Cornelissen, A.K. and Staff (1965). Criticism of, and addendum to, the accompanying paper "Progress report on the geology of the O'okiep Copper District" by P.C. Benedict et al., 1964. Internal report (unpubl.), O'okiep Copper Company Limited.
- Blignault, H.J., Van Aswegen, G., Van Der Merwe, S.W. and Colliston, W.P. (1983). The Namaqualand Geotraverse and Environs: Part of the Proterozoic Namaqua Mobile Belt. In: Botha, B.J.V., ed., Namaqualand Metamorphic Complex, Spec. Publ. Geol. Soc. S.Afr., 10, 1-29.

- Blignault, H.J., Jackson, M.P.A., Beukes, G.J., and Toogood, D.J. (1974). The Namaqua tectonic province in South West Africa. In: Kröner, A., Ed., Contributions to the Precambrian geology of Southern Africa: Bull. Precambrian Res. Unit, Univ. Cape Town, 15, 29-47.
- Blignault, H.J., Van Aswegen, G., and Van der Merwe, S.W. (1981). Review of the intrusive, structural and metamorphic history of the Namaqualand geotraverse and environs, 1-20. In: Blignault, H.J. (Compiler), Guide Namaqualand excursion; South African Geodynamics Project. Pre-Geocongress '81 Excursion A3, Geological Society of South Africa, 50pp.
- Boer, R.H., Schoch, A.E. and De Bruijn, H. (1988). The mineral chemical role of volatile substances in the Koperberg Suite, Namaqualand. Ext. Abstr. Geocongr. '88, 31-34.
- Boer, R.H. (1989). The petrogenesis of the glimmerite occurrences in the Koperberg Suite, Namaqualand. M.Sc thesis (unpubl.), Univ. Orange Free State, 183pp.
- Boer, R.H., Schoch, A.E., Conradie, J.A. and De Bruijn, H. (1987). Investigation of the petrochemical properties of the Koperberg Suite. Internal Report (unpubl.), Copper District Project, Gold Fields of S. Afr., 38pp.
- Boer, R.H. and Schoch, A.E. (1990). Petrogenetic aspects of the copper-bearing Koperberg Suite, Namaqualand, South Africa. Ext. Abstr. 15th Colloquium of Afr. Earth Sci., 89-95.
- Boer, R.H. and Schoch, A.E. (1990). Petrogenetic significance of the glimmerite occurrences in the Okiep Copper District, Namaqualand. EGRU Inform. Circ. No. 221, 18pp.
- Brink, C.F. (1761). The journal of Carel Frederik Brink of the journey into Great Namaqualand (1761-2) made by Captain Hendrik Hop, In: Mossop, E.E., Ed., (1947), Van Riebeeck Society, 28, 160pp.
- Chalmers, J.A. (1900). Notes on the Namaqualand Copper District (London, Institution of Mining and Metallurgy). Reprinted from the Transactions of the Institution of Mining and Metallurgy, vol. 8, (1899-1900).
- Clifford, T.N., Gronow, L., Rex, D.C. and Burger, A.J. (1975a). Geochronological and petrogenetic studies of highgrade metamorphic rocks and intrusives in Namaqualand, South Africa. J. Petr. 16, 154-188.
- Clifford, T.N., Stumpfl, E.F. and McIver, I.R. (1975b). A sapphirine-cordierite-bronzite-phlogopite paragenesis from Namaqualand, South Africa. Mineral. Mag. 40, 347-356.
- Clifford, T.N., Stumpfl, E.F. and Burger, A.J. (1978). Mineralogical and isotopic studies of the crystalline rocks of the Okiep-Nababeep District, Namaqualand. In: W.J. Verwoerd, ed., Mineralization in Metamorphic Terranes. Spec. Publ. Geol. Soc. S. Afr. 4, 345-347.

- Clifford, T.N., Stumpfl, E.F., Burger, A.J., McCarthy, T.S. and Rex, D.C. (1981). Mineral-chemical and isotopic studies of Namaqualand granulites, South Africa: a Grenville analogue. *Contrib. Mineral. Petr.* 77, 225-250.
- Conradie, J.A. (1983). Petrological and petrochemical aspects of the Koperberg Suite, Namaqualand. M.Sc dissertation (unpubl.), Univ. O.F.S., pp.138.
- Conradie, J.A. and Schoch, A.E. (1986). Petrographical characteristics of the Koperberg Suite, South Africa - an analogy to massif-type anorthosites? *Precambrian Res.* 31, 157-188.
- Conradie, J.A. and Schoch, A.E. (1986). Iron-titanium oxide equilibria in copper-bearing diorites, Namaqualand. *Trans. Geol. Soc. S. Afr.*, 89, 29-34.
- Conradie, J.A. and Schoch, A.E. (1988). Rare earth element geochemistry of an anorthosite-diorite suite, Namaqua mobile belt, South Africa. *Earth Plan. Sci. Let.* 87, 409-422.
- Cornelissen, A.K. (1957). A comparative analyses on barren and mineralised core from Nababeep West. Internal report (unpubl.) O'okiep Copper Company Limited.
- Cornelissen, A.K. (1958). Note on botryoidal and stalactitic copper ores from Namaqualand. *Trans. Geol. Soc. S. Afr.*, 61, 367-376.
- Cornell, F.C. (1911). Prospecting and exploring in Klein Namaqualand. *The State*, vol. 6.
- Cornell, F.C. (1920). The glamour of prospecting: Wanderings of a South African prospector in search of copper, gold, emeralds and diamonds, London, T. Fisher Unwin, 336pp.
- De Beer, J.H. and Meyer, R. (1983). Geoelectrical and gravitational characteristics of the Namaqua-Natal mobile belt and its boundaries. In: Botha, B.J.V., Ed., *Namaqualand Metamorphic Complex*, Spec. Publ. Geol. Soc. S.Afr. 10, 91-100.
- De Mist, J.A. (1802). Memorandum containing recommendations for the form and administration of government at the Cape of Good Hope, In: Mossop, E.E., Ed., (1920), *Van Riebeeck Society*, 3, pp.292.
- De Villiers, J. (1968). Sixth Ann. Rep. Precambrian Res. Unit, Univ. Cape Town. 36pp.
- Dechow, E. and Jensen, M.L. (1965). Sulphur isotopes of some Central African sulphide deposits. *Econ. Geol.*, 60, 894-941.
- Dowdle, K. (1955). A bibliography of Namaqualand, Cape Town, University School of Librarianship.

- Dunn, E.J. (1872). Report on the country traversed by the "Gold Prospecting Expedition" in Namaqualand. Parliamentary report No. G-21, Cape Good Hope.
- Elliot, C.H. (1958). Special magnetic interpretation outline for O'okiep Copper Company Limited. Internal Report (unpubl.), Newmont Exploration Limited.
- Fannin, M.G. (1928). The first attempts at mining in Namaqualand. The Mining and Industrial magazine, 7.3.1928.
- Ferris, M. (1978). The geology of Swanson's West Prospect, Internal report (unpubl.), O'okiep Copper Company Limited.
- Gadd-Claxton, D.L. (1974). Reconnaissance geology of the farm Eendoorn. Internal report (unpubl.), O'okiep Copper Company Limited.
- Geological Society of South Africa, (1975). 15th Congress Stellenbosch, Pre-congress excursion guide book No. 1, 73pp.
- Genis, L.M. (1968). The geology of Waaihoek prospect. Internal report (unpubl.), O'okiep Copper Company Limited.
- Genis, L.M. (1969). The geology of Kliphoog. Internal report (unpubl.), O'okiep Copper Company Limited.
- Genis, L.M., Bruwer, J.H. and Nieuwoudt, A.P.C. (1975). The main geological features of some of the larger mines in the O'okiep Copper District. Abstr. 16th Congress Geol. Soc. S. Afr. (Stellenbosch), 43-45.
- Goodwin, A.J.H. (1956). Metal working among the Early Hottentots. The South African Archaeological Bulletin.
- Hälbich, I.W. (1978). Minor structures in gneiss and the origin of steep structures in the O'okiep Copper District, In: W.J. Verwoerd, ed., Mineralization in Metamorphic Terranes. Spec. Publ. Geol. Soc. S.Afr. 4, 297-322.
- Hanekom, H.J. (1959). Kliphoog North prospect. Internal report (unpubl.), O'okiep Copper Company Limited.
- Hausen, D.M. (1966). Mineralogic and thermal studies of disseminated copper sulphides in ore samples from the Carolusberg Mill of O'okiep Copper Company Limited. Internal report (unpubl.), Newmont Exploration Limited.
- Hausmann, S.G. (1961). Report on the Nama Sediments intersected in borehole KN.10 at Klein Nigramoep. Internal report (unpubl.), O'okiep Copper Company Limited.
- Holland, J.G. and Marais, J.A.H. (1983). The significance of the geochemical signature of the Proterozoic gneisses of the Namaqualand Metamorphic Complex with special reference to the O'okiep Copper District. In: Botha, B.J.V., ed., Namaqualand Metamorphic Complex, Spec. Publ. Geol. Soc. S.Afr. 10, 83-91.

- Hugo, D. (1959). Geophysical Project Report No. A.41221-2. Magnetic method (Klein Nigramoep). Internal report (unpubl.), O'okiep Copper Company Limited.
- Hugo, D. (1962). Geophysical Project Report No. A.41221-4. Magnetic method (Klein Nigramoep). Internal report (unpubl.), O'okiep Copper Company Limited.
- Hugo, D., Maher, M.J. and Maske, S. (1978). A review of the application of the magnetic and gravity methods of prospecting in the Okiep Copper District, 355-383. In: W.J. Verwoerd, ed., Mineralization in Metamorphic Terranes. Spec. Publ. Geol. Soc. S.Afr. 4, 297-322.
- Jack, A.M. (1978). Preliminary report on an area of gneisses in western Namaqualand: A. Repts Precambrian Res. Unit, Univ. Cape Town, 114-123.
- Jensen, M.L. and Dechow, E. (1964). Bearing of sulphur isotopes on the origin of Southern African ore deposits. Programme. Ann. Meet., Geol. Soc. Amer., 101.
- Joubert, P. (1971). The regional tectonism of the gneisses of part of Namaqualand. Bull. Precambrian Res. Unit, Univ. Cape Town 10, 220pp.
- Joubert, P. (1972). Geological survey of part of Namaqualand and Bushmanland. 7-9th Ann. Reports of the Precambrian Res. Unit, Univ. Cape Town, 4-11.
- Joubert, P. (1973). The development of the gneisses of part of Namaqualand, 289-305., In: Lister, L.A., Ed., Symposium on Granites, Gneisses and Related Rocks. Spec. Publ. Geol. Soc. S. Afr., 3, 509pp.
- Joubert, P. (1974). Geological survey of Namaqualand and Bushmanland. Ann. Rep., 1972-73, Precambrian Res. Unit, Univ. Cape Town, 24-30.
- Joubert, P. (1974). Wrench fault tectonics in the Namaqualand Metamorphic Complex, In: Kröner, A., Ed., Contributions to the Precambrian geology of Southern Africa. Bull. Precambrian Res. Unit, Univ. Cape Town, 15, 17-28.
- Joubert, P. (1974). The gneisses of Namaqualand and their deformation. Trans. Geol. Soc. S. Afr., 77, 339-345.
- Joubert, P. (1986). Namaqualand - A model of Proterozoic accretion?. Trans. Geol. Soc. S. Afr., 89, 79-96.
- Kedda, S.W. (1988). The petrography, geochemistry and fluid inclusions of the Spektakel ore-body, Namaqualand. B.Sc. Hons. Proj. (unpubl.), Univ. Witwatersrand, 120pp.
- Kingsbury, H.M. (1919). Report on the geological structure and various mines and prospects of the Concordia District. Internal report (unpubl.), O'okiep Copper Company Limited.



- Kingsbury, H.M. (1925). Report on the Cape Copper District, Namaqualand, South Africa. Internal report (unpubl.), O'okiep Copper Company Limited.
- Koeppel, V. (1978). Lead isotope studies of stratiform ore deposits of Namaqualand, northwest Cape Province, South Africa, and their implications on the age of the Bushmanland Supergroup. Short Papers of the Fourth International Conference, Geochronology, Cosmochronology, Isotope Geology, U.S. Geol. Surv. Open-File Rept 78-701, 223-226.
- Koeppel, V. (1978). Lead isotope studies of stratiform ore deposits of Namaqualand, NW Cape Province, South Africa, and their implications on the age of the Bushmanland Sequence. Proceedings of the Fifth Quadrennial IAGOD Symposium, 195-207.
- Kröner A. (1971). The origin of the southern Namaqualand gneiss complex, South Africa, in the light of geochemical data. Lithos, 4, 325-344.
- Kröner, A. (1974). Short synthesis of the unit's work in the Namaqualand Metamorphic Complex. Univ. Cape Town, Precamb. Res. Unit, 10th & 11th A. Repts., 57-59.
- Kröner, A. and Blignault, H.J. (1976). Towards a definition of some tectonic and igneous provinces in western South Africa and southern South West Africa. Trans. Geol. Soc. S. Afr., 79, 232-238.
- Kuntz, J. (1904). Copper ore in South-west Africa. Trans. Geol. Soc. S. Afr., 7 (2), 70-77.
- Latsky, R. (1942). The magmatic copper ores of Namaqualand. Trans. Geol. Soc. S.Afr. 45, 109-150.
- Letcher, O. (1932). Namaqualand: Cradle of mineral development in Southern Africa. A series of articles constituting an outline of the history and development of the territory and a survey of it's main physical features, geology and mineralization. The Mining and Industrial Magazine.
- Levin, M. (1978). Uranium occurrences in the Gordonia and Kuruman Districts. Atomic Energy Board report, PER-37, pp.31.
- Lombaard, A.F. and Schreuder, F.J.G. (1978). Distribution Pattern and General Geological Features of Steep Structures, Megabreccias and Basic Rocks in the Okiep Copper District. In: W.J. Verwoerd, ed., Mineralization in Metamorphic Terranes, Spec. Publ. Geol. Soc. S.Afr. 4, 269-295.
- Lombaard, A.F. and the Exploration Department Staff of the O'okiep Copper Company Limited (1986). The Copper Deposits of the Okiep District, Namaqualand. In: C.R. Anhaeusser, and S. Maske, Eds., Mineral Deposits of Southern Africa, 2, 1421-1445.

- Louw, A.C. (1975). A preliminary account of the structural geology of the Klondike "steep structure" in the Okiep Copper District. Geol. Soc. S. Afr. Congress Abstr. 16th Sess. (Stellenbosch), 82-83.
- Louw, A.C. (1975). Reconnaissance geology of the farm Biesjesfontein, remainder of portion 1 (Voëlklip) and Biesjesfontein portion 16, 17 and 21. Internal report (unpubl.), O'okiep Copper Company Limited.
- Marais, J.A.H. (1955). Report on the Geology of the Springbok-Tweedam area. Internal report (unpubl.), O'okiep Copper Company Limited.
- Marais, J.A.H. (1959). Geology of block 244 from Kliphoog to Garracoup Valley. Internal report (unpubl.), O'okiep Copper Company Limited.
- Marais, J.A.H. and Hanekom, H.J. (1958). The geology of the Harvey Claim area. Internal report (unpubl.), O'okiep Copper Company Limited.
- Marais, J.A.H., Packham, B. de V. and Wheatley, C. (1975). Excursion through the O'okiep Copper District. Geol. Soc. S. Afr., XVith Congress, Guide Book 2, 18-25.
- Marais, J.A.H., Packham, B. de V. and Schreuder, F.G.J. (1975). The regional geology of the O'okiep Copper District. (Abstr.) Geocongress '75, Geol. Soc. S. Afr., 88-89.
- Marais, J.A.H. (1980). Koperberg Suite, 317-319. In: SACS (Compiler, L.E. Kent), Stratigraphy of South Africa, Part 1, Handb. Geol. Surv. S. Afr., 8, 690pp.
- Marais, J.A.H. and Joubert, P. (1980). Little Namaqualand Suite, 294-299. In: SACS (Compiler, L.E. Kent), Stratigraphy of South Africa, Part 1, Handb. Geol. Surv. S. Afr., 8, 690pp.
- Marais, J.A.H. and Joubert, P. (1980). Spektakel Suite, 314-316. In: SACS (Compiler, L.E. Kent), Stratigraphy of South Africa, Part 1, Handb. Geol. Surv. S. Afr., 8, 690pp.
- Marais, J.A.H. (1981). The geology of the O'okiep Copper District of Namaqualand with special reference to the sequence of the main intrusive and structural events. Geocongress 81, S.A. Geodynamics Symposium, Abstracts of papers, Geol. Soc. S. Afr., 137-138.
- Marais, J.A.H. (1987). O'okiep Copper Company Ltd; 1937-1987. 50th Anniv. Comm. Broc., 44pp.
- Martin, H. (1965). The Precambrian Geology of South West Africa and Namaqualand, Precambrian Res. Unit, Univ. Cape Town. 159pp.
- Martin, H. (1969). Problems of age relations and structure in some metamorphic belts of Southern Africa. Spec. Pap. Geol. Ass. Canada, 5, 17-26.

- Mathias, M. (1941). A comparative study of the Namaqualand granites. *Trans. Geol. Soc. S. Afr.*, 43 (1940), 175-203.
- McCarthy, T.S. (1975). A geochemical study of the gneisses of the Nababeep District, Namaqualand. 16 *Congr. Geol. Soc. S. Afr.*, vol. Abstracts, 84-87.
- McCarthy, T.S. (1976). Chemical interrelationships in a low-pressure granulite terrain in Namaqualand, South Africa, and their bearing on granite genesis and the composition of the lower crust. *Geochim. Cosmochim. Acta* 40, 1057-1068.
- McCarthy, T.S. (1978). A geochemical study of the gneisses of the Nababeep District, Namaqualand. In: W.J. Verwoerd, ed., *Mineralization in Metamorphic Terranes*, Spec. Publ. Geol. Soc. S.Afr. 4, 351-353.
- McDonald, B. (1974). The geology of the Geogab Area (Block A324). Internal report (unpubl.), O'okiep Copper Company Limited.
- McIver, J.R., McCarthy, T.S. and Packham, B. de V. (1983). The Copper-bearing Basic Rocks of Namaqualand, South Africa. *Mineral. Deposita* 18, 135-160.
- Moffat, R. (1858). Report of a survey of a portion of the Orange River, eastward of Little Namaqualand. *Parliamentary Report Cape of Good Hope*, 12pp.
- Moore, J.M. (1980). A study of certain paragneiss associations and their metallogenic characteristics in Namaqualand and Bushmanland, Ann. Rep. Precambrian Res. Unit, Univ. Cape Town, 17, 65-73.
- Moore, J.M. (1989). A comparative study of metamorphosed supracrustal rocks from the Western Namaqualand Metamorphic Complex. *Bull. Precambrian Res. Unit, Univ. Cape Town* 37, 370pp.
- Muller, J.A. (1959). Geophysical Project Report No. A.41221-1. Physical properties (Klein Nigraemoep). Internal report (unpubl.), O'okiep Copper Company Limited.
- Muller, J.A. (1964). Geophysical Project Report No. A.41221-5. Magnetic method (Klein Nigraemoep). Internal report (unpubl.), O'okiep Copper Company Limited.
- Muller, J.A. (1973). A review of magnetic property measurements of the major rock types in the Copper District. Internal report (unpubl.), O'okiep Copper Company Limited.
- Muller, J.A., Maher, M.J. and Saal, E.W. (1978). The significance of natural remnant magnetization in geophysical exploration in the O'okiep Copper District, 385-401. In: W.J. Verwoerd, ed., *Mineralization in Metamorphic Terranes*, Spec. Publ. Geol. Soc. S.Afr. 4, 269-295.

- Muller, J.A. and Smit, G.J. (1983). A geophysical study along a profile from Garies to Vioolsdrift across the Okiep Copper District. Spec. Publ. Geol. Soc. S. Afr., 10, 139-146.
- Nicolaysen, L.O. and Burger, A.J. (1965). Note on an extensive zone of 1000 million year old metamorphic and igneous rocks in Southern Africa. Sci. de la Terre, 10, 497 - 516.
- Packham, B. De V. (1982). Evaluation of Klein Nigraemoep Prospect. Internal report (unpubl.), O'okiep Copper Company Limited.
- Pennebaker, E.N. (1947). Geology and ore deposits of the Little Namaqualand Copper District. Internal report (unpubl.), O'okiep Copper Company Limited.
- Pennebaker, E.N. (1952). Review of geology and exploration for the O'okiep Copper Company Ltd., Internal report (unpubl.), O'okiep Copper Company Limited.
- Pepler, J.S. (1959). Geological report on the Klein Nigraemoep Prospect. Internal report (unpubl.), O'okiep Copper Company Limited.
- Pepler, J.S. (1962). Geochemical sampling of the base of the Nama Sediments on K.5 Klein Nigraemoep Prospect. Internal report (unpubl.), O'okiep Copper Company Limited.
- Piper, J.D.A., Briden, J.C., and Lomax, K. (1973). Precambrian Africa and South America as a single continent. Nature, Lond., 245, 244-248.
- Prins, P. (1970). Geochemical and mineralogical variations in the wall rocks of copper-bearing bodies, Namaqualand. Unpubl. M.Sc., Univ. of Stellenbosch.
- Prins, P. (1972). A thermal aureole around the Homeep East mafic body, Namaqualand. Trans. Geol. Soc. S. Afr., 75, 165-175.
- Prins, P. and Venter, J.P. (1978). Primary dispersion aureoles associated with copper-bearing mafic bodies, Namaqualand. In: W.J. Verwoerd, ed., Mineralization in Metamorphic Terranes, Spec. Publ. Geol. Soc. S. Afr. 4, 331-344.
- Quentrall, T. and Ronaldson, J.H. (1905). Report to the Government of the Cape of Good Hope on the Mineral Resources of Namaqualand.
- Read, H.H. (1952). Metamorphism and granitisation: Alex L. du Toit Memorial Lecture, Annexure to vol. 54, Trans. Geol. Soc. S.Afr., 27pp.
- Reid, D.L. (1981). Sm-Nd ages from the Namaqua and Richtersveld Provinces. Geocongress 81, S. Afr. Geod. Symp., Abstracts of papers, Geol. Soc. S. Afr., 173-174.

- Reid, D.. and Barton, E.S. (1983). Geochemical characterization of granitoids in the Namaqualand Geotraverse. In: B.J.V. Botha, Ed., Namaqualand Metamorphic Complex, Spec. Publ. Geol. Soc. S.Afr. 10, 67-82.
- Robb, L.J. (1982). A review of magmatic differentiation in granites from the Springbok region, Namaqualand. Report submitted to AEC (unpubl.).
- Robertson, J.K. (1968). The history of the Narrow Gauge Railways in South Africa, University of South Africa, Department of Librarianship.
- Rogers, A.W. (1912). Report on a portion of Namaqualand. A. Rep. Geol. Surv. S. Afr., 125-152.
- Rogers, A.W. (1916). The nature of the copper deposits of Little Namaqualand. Proc. Geol. Soc. S. Afr., 19, 21-35.
- Rogers, A.W. (1916). The geology of part of Namaqualand. Trans. Geol. Soc. S.Afr., 18 (1915), 72-101.
- Rogers, A.W. (1917). An old report on the Copper Field of Namaqualand. S. Afr. Jour. Sci., 146-152.
- Rogers, A.W. (1937). The pioneers in South African Geology and their work. Annexure. to vol. 39, Trans. Geol. Soc. S.Afr. 139pp.
- Ronaldson, J.H. (1905). Notes on the copper deposits of Little Namaqualand. Trans. Geol. Soc. S. Afr., p158.
- Rowe, C. (1884). Correspondence with Cape Copper Company. In: A.K. Cornelissen, (1966). The history of copper mining in Namaqualand up to 1937 (unpubl.).
- Rubidge, R.N. (1856). Notes on the Geology of some parts of South Africa. Quart. J. Geol. Soc. London 12, 1, 237-238.
- SACS (1980). (Compiler, L.E. Kent) Stratigraphy of South Africa, Part 1. Handb. Geol. Surv. S. Afr., 8, 690pp.
- Saal, E.W. (1975). Physical properties report No.A31324-1; Carolusberg Central; Specific gravity. Internal report (unpubl.), O'okiep Copper Company Limited.
- Schenk, A. (1902). Die Kupfererzlagertstätten von O'okiep in Klein Namaqualand. Zeit. de deutsch. geol. Ges. Verhand. der Ges., 53, p.64.
- Schoch, A.E., Boer, R.H. and Conradie, J.A. (1989). Internal report: Copper District Project. (unpubl.).
- Schoch, A.E. and Conradie, J.A. (1990). Petrochemical and mineralogical relationships in the Koperberg Suite, Namaqualand, South Africa. Am. Miner., 75, 27-36.

- Scrutton, R.A. (1972). Gravity results from the continental margin of south-western Africa. *Mar. Geophys. Researches*, 2, 11-21.
- Smalberger, J.M. (1975). Aspects of the History of Copper mining in Namaqualand 1846-1931, Struik (Pty) Ltd., Cape Town, 152pp.
- Smit, G.J. (1981). Geophysical Project Report No. 2917DAA-4. Downhole IP Method (Klein Nigramoep). Internal report (unpubl.), O'okiep Copper Company Limited.
- Smit, G.J. and Muller, J.A. (1983). A Statistical Study of Aeromagnetic Anomaly Trends and Aeromagnetic Lineaments in and around the Okiep Copper District, Namaqualand. In: B.J.V. Botha, Ed., *Namaqualand Metamorphic Complex*, Spec. Publ. Geol. Soc. S. Afr. 10, 131-137.
- Smit, G.J. and Murray, P.G. (1975). Computer applications in exploration at O'okiep. Internal report (unpubl.), O'okiep Copper Company Limited.
- Smit, P.J., Hales, A.L. and Gough, D.I. (1962). The gravity survey of the Republic of South Africa. Part 1: Gravimeter observations. *Handb. Geol. Surv. S. Afr.*, 3, 484pp.
- Söhnge, P.G. (1947-50). Annual geological report of the O'okiep Copper Company Limited, Internal report (unpubl.), O'okiep Copper Company Limited.
- Söhnge, P.G. (1963). Genetic problems of pipe deposits in South Africa. *Presid. Addr., Proc. Geol. Soc. S. Afr.*, 66, xix-1xxii.
- Steyn, P. (1975). Note on compositional variation of biotite in basic rocks of the O'okiep copper District, *Abstr. of Papers*, 16th Geocongress 75, Stellenbosch, 131.
- Strauss, C.A. (1941). The geology, copper ore deposits and groundwater hydrology of the area around Springbok and O'okiep, Namaqualand: D.Sc thesis (unpubl.), Univ. Stellenbosch, 166pp.
- Stumpf1, E.F. (1978). Variations in silicate, oxide and sulphide mineralogy in the Okiep Copper District. In: W.J. Verwoerd, Ed., *Mineralisation in metamorphic terranes*, Spec. Publ. Geol. Soc. S.Afr. 4, 349-350.
- Stumpf1, E.F., Clifford, T.N., Burger, A.J. and Van Zyl, D. (1976). The Copper Deposits of the O'okiep District, South Africa: New Data and Concepts. *Mineral. Deposita* 11, 46-70.
- Theart, H.F.J. (1980). The geology of the Precambrian terrane in parts of western Namaqualand. *Bull. Precambrian Res. Unit*, Univ. Cape Town, 19, 103pp.
- Truswell, J.F. (1970). An introduction to the historical geology of South Africa. Purnell, Cape Town.

- Van Aswegen, G. (1988). The Evolution of the Proterozoic Gneisses and other Metamorphites between Springbok and Vioolsdrif, South Africa. Unpubl. Ph.D thesis, Univ. of the Orange Free State. 167pp.
- Van Aswegen, G., Strydom, D., Colliston, W.P., Preakelt, H.E., Schoch, A.E., Blignault, H.J., Botha, B.J.V. and Van der Merwe, S.W. (1987). The structural-stratigraphic development of part of the Namaqua Metamorphic Complex, South Africa - An example of Proterozoic major thrust tectonics. In: Kröner, A., Ed., Proterozoic Lithospheric Evolution, 207-216.
- Van der Merwe, S.W. (1988). The structural development of part of the Namaqua Mobile Belt, in an area between Springbok and Vioolsdrift. Ph.D. thesis (unpubl.), Univ. Orange Free State.
- Van Zijl, J.S.V. (1978). The relationship between the deep electrical resistivity structure and tectonic provinces in Southern Africa, Part 1, Results obtained by Schlumberger soundings. Trans. Geol. Soc. S. Afr., 81, 129-142.
- Van Zyl, D. (1965). The geology of the O'okiep Copper Mine, Namaqualand. M.Sc thesis (unpubl.), Univ. Stellenbosch.
- Van Zyl, D. (1967). The geology of the O'okiep Copper Mine Namaqualand. Annals Univ. Stellenbosch, 42, Ser. A, No. 1, 1-68.
- Van Zyl, D. (1969). The geology at Carolusberg West between 1170 and 1890 levels. Internal report (unpubl.), O'okiep Copper Company Limited.
- Van Zyl, D. (1971). The petrogenesis of the Namaqualand ore-bodies. Internal report (unpubl.), O'okiep Copper Company Limited.
- Van Zyl, D. (1972). The preliminary evaluation of two low-grade basic bodies at Homeep West. Internal report (unpubl.), O'okiep Copper Company Limited.
- Van Zyl, D. (1974). The geology of the basic rocks in Carolusberg West Mine below the 2790 level. Internal report (unpubl.), O'okiep Copper Company Limited.
- Van Zyl, D. (1974). The economic significance of petrological features of the O'okiep basic intrusives. Internal report (unpubl.), O'okiep Copper Company Limited.
- Van Zyl, D. (1978). A petrological approach towards the ore-bearing potentialities of the O'okiep basic intrusives in Namaqualand. In: W.J. Verwoerd, ed., Mineralisation in metamorphic terranes, Spec. Publ. Geol. Soc. S.Afr. 4, 323-329.

- Van Zyl, D. (1988). A reconnaissance study on the petrochemical characteristics of the Koperberg Suite rocks as a function of their ore-bearing potentialities. Internal report (unpubl.), Gold Fields of S. Afr. Ltd.
- Van Zyl, D. (1989). Notes on the ore-bearing potential of the Klein Nigramoep basic intrusive. Internal report (unpubl.), O'okiep Copper Company.
- Vajner, V. (1974). Crustal evolution of the Namaqua Mobile Belt and its foreland in parts of the northern Cape. P.R.U., Univ. Cape Town, Bull. 15, 1-15.
- Vajner, V. (1974). Note on the Precambrian tectonic history of parts of the Namaqua front and foreland in the northern Cape. Ann. Rep., 1972-73, Precambrian Res. Unit, Univ. Cape Town, 14.
- Vellet, V. (1958). The geology of the Copper District, Namaqualand, Cape Province, South Africa. Ph.D thesis (unpubl.), Univ. Stellenbosch.
- Vellet, V. (1958). The geology of the Copper District, Namaqualand, Cape Province, South Africa. Internal report (unpubl.), O'okiep Copper Company Limited.
- Venter, J.P. (1970). Trace element dispersion in wall rocks of copper-bearing bodies, Namaqualand. M.Sc thesis (unpubl.), Univ. Stellenbosch, 72pp.
- Venter, L.C. (1984). Geometriese en vervormingsanalises op enkele steilstrukture van die Okiep-Koperdistrik. Unpubl. M.Sc diss., Univ. of the Orange Free State. 211pp.
- Venter, P.P. (1951). The petrology of the Nababeep and Brandberg gneisses. M.Sc thesis (unpubl.), Univ. Pretoria, 74pp.
- Von Zeil, A.L. (1988). Assessment of the exploration potential for columbite, tantalite, scheelite, wolframite and molybdenite of the farm Klein Ezels Fontein ptn. 7 of ptn. 3 (block A423) with reference to Swanson's West Prospect on the property, and an evaluation of the copper potential of the latter prospect. Internal report (unpubl.), O'okiep Copper Company Limited, 15pp.
- Waterhouse, G. (1932). Simon van der Stel's Journal of his Expedition to Namaqualand, 1685/6; edited from the manuscript in the Library of Trinity College Dublin, London, Longmans, Green.
- Waters, D.J. (1986). Metamorphic zonation and thermal history of pelitic gneisses from Western Namaqualand, South Africa. Trans. Geol. Soc. S. Afr., 89, 2, 97-102.
- Weilers, B.F. (1964). The status of exploration at the Klein Nigramoep and Klein Nigramoep East prospects. Internal report (unpubl.), O'okiep Copper Company Limited.



- Wiid, D. de N. (1951). Annual geological report of the O'okiep Copper Company Ltd. (unpubl.).
- Wikaar, H.J. (1779). The journal of Hendrik Jacob Wikaar. In: E.E.Mossop, ed., 1935, Van Riebeeck Society, 15, 323pp.
- Wright, I.H. (1963). The geochemistry of the alkali metals, alkaline earth metals and fluorine in some Namaqualand gneisses from the O'okiep and Bitterfontein areas of South Western Cape. Geochem. B.Sc. Hons. Proj., Univ. Cape Town.
- Wyley, A. (1856). Provisional report upon the nature and general character of the Copper Districts of South Namaqualand: Parliamentary report No. G-36, Cape Good Hope, 6pp.
- Wyley, A. (1857). Report upon the mineral and geological structure of South Namaqualand and the adjoining mineral districts: Parliamentary report No. G-36, Cape Good Hope, 55pp.
- Zelt, G.A.D. (1979). A geotraverse across Namaqualand, South Africa: The petrology, geochemistry and structural relations of a Proterozoic high-grade metamorphic terrain. Ph.D. thesis (unpubl.), Univ. Natal, 203pp.
- Zelt, G.A.D. (1980). Granulite metamorphism in Namaqualand, South Africa. Precambrian Res., 13, 253-274.
- Zerrener, C. (1860). Reise des Ingenieurs A. Thiers nach den Kupfer Bergwerken Namaqualand in Süd Afrika. Berg. u. Hüttenm., Zeitung, p.41.