CHAPTER THREE: STRATIGRAPHY

The first detailed description of the geology of the Platreef was provided by Buchanan (1979). Based on compositional and modal variation at Sandsloot, Buchanan (1979) and White (1994) distinguished three layers, the A, B, and C-reefs from base to top. Subsequent workers studied the reef on the farms Tweefontein (Buchanan et al., 1981), Zwartfontein (Kinloch, 1982), Drenthe (Gain and Mostert, 1982), Overysel (Cawthorn et al. 1985), Sandsloot (Harris and Chaumba, 2001 and Armitage et al., 2002) and Townlands (Maier, 2003; submitted) (see Fig. 3.1 for localities). Maier (2003; submitted) suggested that on the farm Townlands, several km to the south of Sandsloot, the three reef zones can equally be identified, but that they are separated by shale interlayers.

At Sandsloot open pit mine, the mine geologists describe the A-reef as a feldspathic, pegmatoidal, pyroxenitic to noritic unit with a heterogeneous texture containing low-grade disseminated mineralisation and commonly some large blebs of composite base metal sulphides. The B-reef is a coarse grained feldspathic pyroxenite. The pyroxenite locally contains some chromite and visible disseminated base metal sulphide mineralisation (mainly pyrrhotite and chalcopyrite). The unit also hosts barren noritic bodies, up to 10's of meters in width that tend to be fine-grained in the centre and coarser grained (occasionally pegmatoidal) at the margins. These rocks are termed hybrid norite by the mine geologists. It is not yet clear whether this 'hybrid norite' is a distinct intrusive phase or represents metasomatised xenoliths. The C-reef

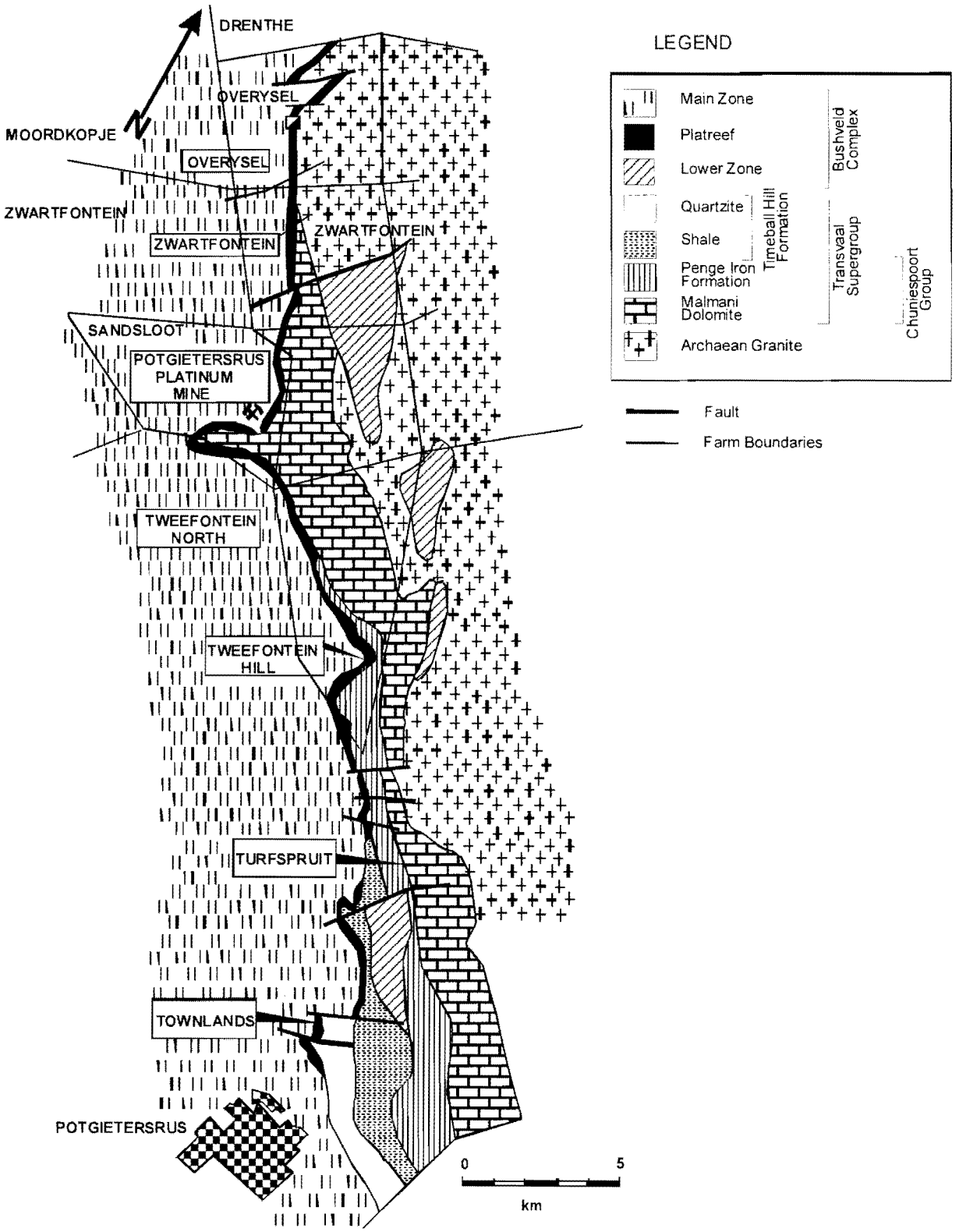

Fig 3.1: Regional geological map of the Potgietersrus limb indicating the location of mineralised sections. (modified after White, 1994).

is a fine grained feldspathic pyroxenite with a 'brown sugar texture' and is normally barren. It is overlain, usually with a relatively sharp contact, by the Main Zone gabbronorites.

On the farm Townlands, the platiniferous rocks show less lithological variation, and the pegmatoidal pyroxenite classified as A-reef on Sandsloot is not developed here. Instead there are three packages of medium-grained feldspathic pyroxenite -to gabbronorite separated by hornfels interlayers. Therefore, if the modal and textural classification applied at Sandsloot is to be followed, it appears that at Townlands, the A- and the C-reefs are not developed.

The three pyroxenite/gabbronorite horizons identified at Townlands are somewhat similar in texture and composition to the B-reef at Sandsloot. However they display a different mineral and whole rock chemistry, including PGE concentration patterns, as will be discussed in chapter 5 and 6. Therefore, the terminology of the Platreef as applied at Sandsloot will not be applied in this work. Instead, the three platiniferous pyroxenite/gabbronorite layers will be referred to as the Lower, Middle and Upper Platreef units, from the bottom to the top, respectively.

A simplified stratigraphic column of the Platreef lithologies and their floor rocks on the farm Townlands is given in Fig. 3.2. The TL1-03 borehole log is given in Appendix VII. The floor rocks of the Platreef consist of hornfels, quartzite and calcsilicates probably belonging to the early Proterozoic Silverton Formation of the Pretoria Group. The immediate floor to the Platreef is formed by a 10 m quartzite. The hornfels may

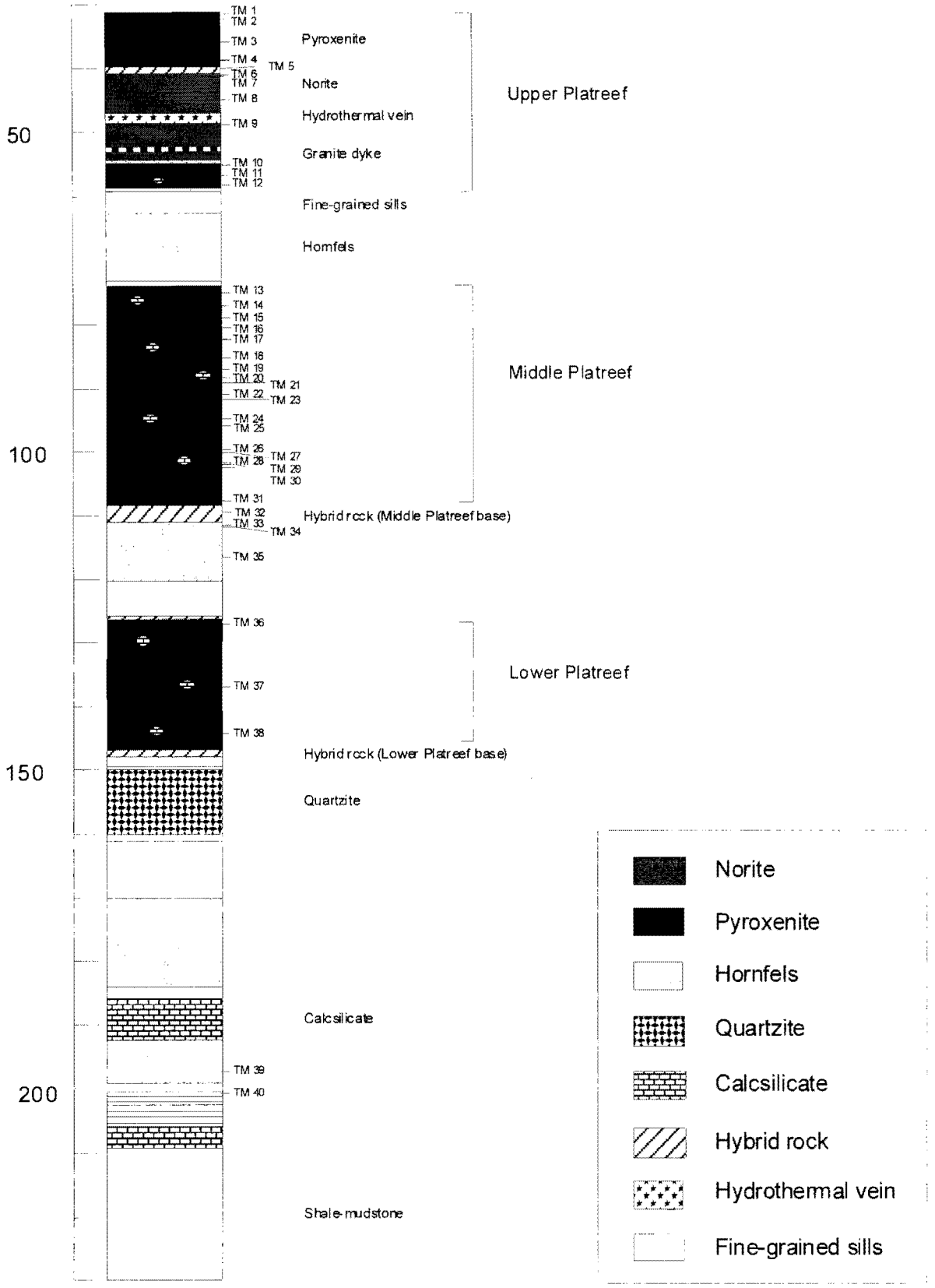

Fig. 3.2: Generalised stratigraphic column through the Platreef on the farm Townlands (scale in meters).

contain fragments of quartzite up to 3 cm in size. Occasionally, the hornfels contains abundant fine mica. The calcsilicates are fine to medium-grained rocks with a light greenish gray to light gray colour. They are locally layered on a centimeter scale with layering defined by thin (1-2mm), dark, olivine bearing layers. The sedimentary rocks are intruded by numerous sill-like bodies of pyroxenite which show internal variation in grain size, from fine-grained at the margins to medium-grained at the centre. The width of the bodies ranges from a few centimeters to several meters. The medium grained pyroxenite bodies have chilled margins at the top and bottom, up to 3 mm in thickness. Thin reaction rims (≤ 2mm) are present between the hornfels and the pyroxenites, but apart from that, the contacts between the intrusions and the sedimentary rocks are sharp.

The Lower Platreef is largely noritic in composition, with less abundant pyroxenites. The contact between the Lower Platreef and the quartzitic floor rocks is formed by a hybrid zone which consists of metasedimentary rocks apparently injected by pyroxenite. Alternatively, the package may represent pyroxenite containing a dense load of sedimentary xenoliths. A clear distinction between the two possibilities is not possible in the core.

A ca ~9 m interlayer of ferruginous hornfels separates the Lower Platreef from the Middle Platreef. The hornfels contains a fine-grained, greenish-gray, pyroxenite (116.68 – 121.00 m) containing hornfels xenoliths generally 5-18 cm in size (i.e. at 116.80 – 118.86, 117.85 – 117.95, 118.70 – 118.77 and 119.81 – 119.98 m). The contacts between the hornfels xenoliths and the fine-grained pyroxenite are sharp. A

thin whitish reaction rim (1-2 mm) composed of quartz and feldspar occurs between the fine-grained pyroxenite and the hornfels xenoliths. Towards the top of the hornfels interlayer, the sedimentary rock displays layering defined by 2-5 cm serpentinised dolomite bands alternating with light-green, fine to medium grained, diopside-rich zones developed at 108.22 – 108.34 and 108.58 -108.63 m.

The Middle Platreef is approximately 35 m thick and consists mainly of a medium grained, olivine bearing, feldspathic pyroxenite/gabbronorite with a heterogeneous texture. Pegmatoidal patches are abundant and are due to a local increase in modal proportion and grain size of feldspars intergrown with dark, grayish-green, altered, olivine and pyroxene. Coarse sulphides of up to 3 cm in size are preferably associated with the felsic pegmatoidal domains, whereas fine-grained sulphides are found in the more even-textured pyroxenite/gabbronorite. Xenoliths of metadolomite are abundant. The xenoliths have gradational contacts with the igneous rocks marked by a progressive increase in modal olivine in the latter. Interaction between the xenoliths and the intrusive rocks is also evident by means of coarse-grained to pegmatoidal textures around the xenoliths.

A ca. 10 m hornfels interlayer (similar to the one described earlier) overlain by a 3 m fine-grained pyroxenite sill (59.55 – 62.83m) separates the Middle Platreef from the Upper Platreef. The hornfels is fine- to medium grained and dark coloured. Layering is locally developed in the hornfels and defined by thin (1-2 mm) leucocratic quartzofeldspathic layers about 4 cm apart alternating with dark-coloured magnetite-rich portions. Massive magnetite is also locally present especially towards the base of

the hornfels interlayer. It occurs as narrow (< 2 cm wide) zones and blebs. Also towards the base, the hornfels becomes mottled as a manifestation of an increase in quartz and feldspar content relative to the upper portions. Finely disseminated interstitial sulphides, mostly pyrite and minor pyrrhotite, are present in minor proportions. The pyroxenite sills are fine-grained and contain traces of fine-grained sulphides (mostly pyrrhotite).

Overlying the fine-grained pyroxenite sill is a 75 cm hybrid zone similar to the one described earlier. This is in turn overlain by a medium-grained feldspathic pyroxenite/gabbronorite belonging to the Upper Platreef, similar in appearance to the Middle Platreef. The pyroxenite/gabbronorite has about 12 % interstitial plagioclase in the upper portions decreasing to about 3 % in the lower portions. Sulphides are present in the form of fine interstitial pyrrhotite and minor chalcopyrite, but locally massive sulphides form (i.e. in an 8 cm zone between 57.63 – 57.71 m).This is overlain by a 45 cm hornfels and a medium grained norite (153.04 – 41.44 m). A granite dyke occurs at 53.05-53.61 m.

The norite has a markedly different appearance to the Platreef pyroxenite/gabbronorite. It contains 50 – 60 % plagioclase and 40-50 % orthopyroxene. Minor (< 1 %) sulphides (chalcopyrite and pyrrhotite) occur as fine disseminations within the norite.

The granite dyke contains two types of feldspars, an orange-coloured variety (K-feldspar), with subhedral crystals averaging 2 mm in size, and a whitish lath-shaped

plagioclase feldspar with crystals ranging from 1 – 5 mm in size. The dyke has sharp contacts with the different rocks below and on top. No chilled zone is evident.

The norite is also cut by a 60 cm hydrothermal vein between 47.6-48.10 m. The hydrothermal vein is pegmatoidal and highly altered. It has an 8 cm light-green coloured epidote enriched zone that altered the rock on either side.

A fine-to medium grained hornfels layer grading into a hybrid zone separates the norite and the overlying part of the Upper Platreef. The hornfels is highly magnetic with magnetite reaching up to 50 modal %. The thickness of the Upper Platreef in the present intersection is not known as the core was collared in overburden overlying the pyroxenite. The upper part of the Upper Platreef (from ~40 m) is a medium grained greenish grey orthopyroxenite with about 10 % intercumulus plagioclase. Minor disseminated sulphides, reaching ca. 2-3 vol. %, are present as blebby intercumulus phases.