

The Bushveld Complex—possibly the most valuable ore deposit in the world?

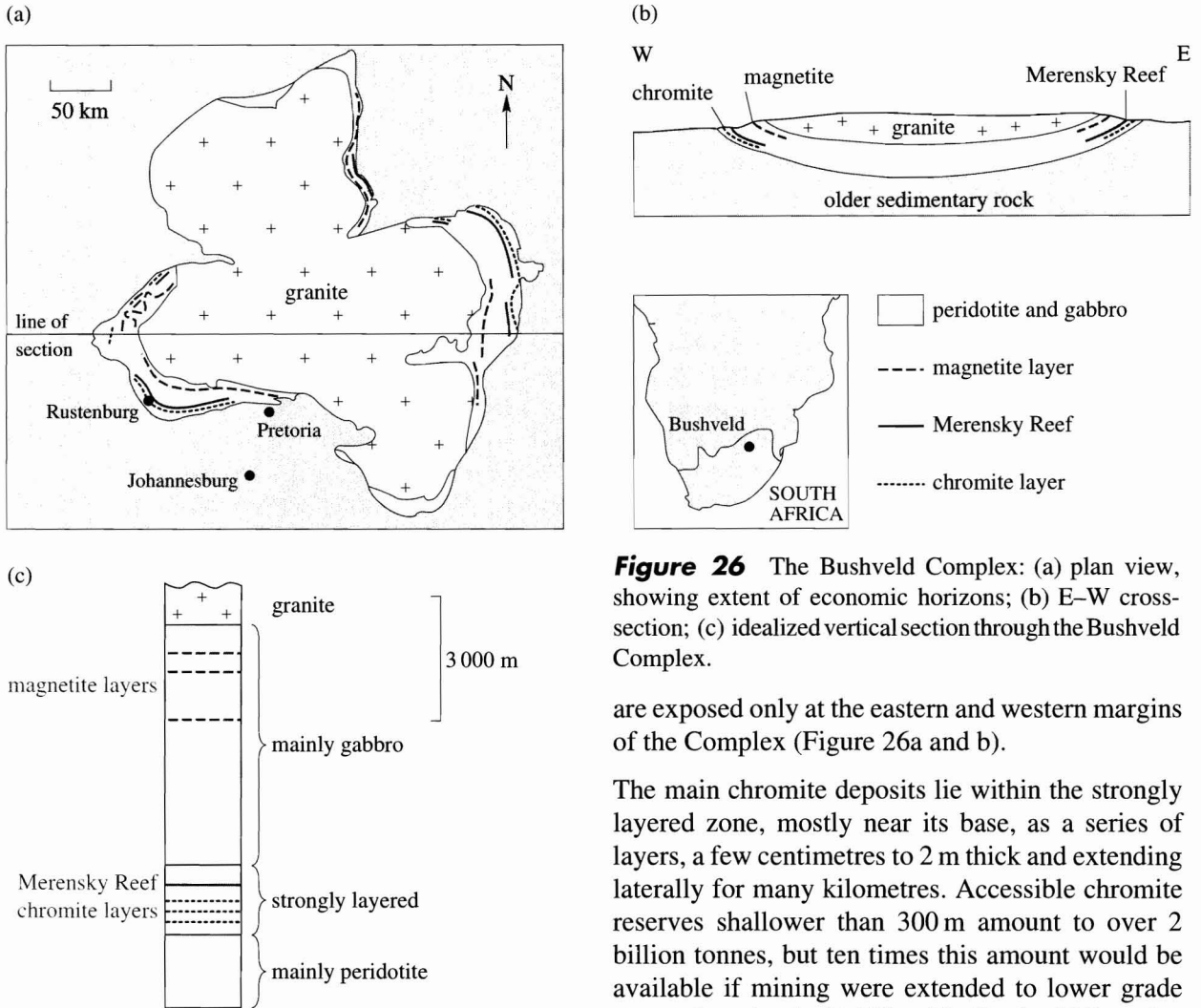


Figure 26 The Bushveld Complex: (a) plan view, showing extent of economic horizons; (b) E–W cross-section; (c) idealized vertical section through the Bushveld Complex.

are exposed only at the eastern and western margins of the Complex (Figure 26a and b).

The main chromite deposits lie within the strongly layered zone, mostly near its base, as a series of layers, a few centimetres to 2 m thick and extending laterally for many kilometres. Accessible chromite reserves shallower than 300 m amount to over 2 billion tonnes, but ten times this amount would be available if mining were extended to lower grade ores and to a depth of 1 200 m. The Bushveld Complex represents about 75% of the world's chromite reserves.

Near the top of the strongly layered zone there is a thin sheet less than 1 m thick comprising coarsely crystalline pyroxene. At its upper and lower margins are thin, centimetre-thick layers containing chromite, but also rich in sulphides, and more importantly, rich in platinum and other precious metals. This sheet is probably the best-known part of the Bushveld intrusion, and is known as the Merensky Reef (Figure 26c), after Hans Merensky, an early prospector. It is mined as a whole unit because the narrow, centimetre-thick layers would be impossible to mine alone. The grade of platinum reaches $7.5\text{--}11\text{ g t}^{-1}$, well above the cut-off grade for platinum of 5 g t^{-1} . Platinum occurs in the Merensky Reef as native metal, as a natural alloy, and also as minerals, such as sulphides, arsenides and antimonides, in association with other precious metals such as palladium, ruthenium, gold, rhodium and iridium.

What is the Bushveld Complex and why should it be one of the world's most valuable ore deposits? Firstly, it is an extremely large, saucer-shaped igneous intrusion (Figure 26b), some 300 km across and 6 to 8 km thick, underlying an area of 67 000 km² just north of Pretoria in South Africa (Figure 26a). Most of this huge, 1 500 billion tonne body, however, is not ore at all; overall it is of basaltic composition, differentiated into a lower part of mainly peridotite and an upper two-thirds of mainly gabbro (Figure 26c). Between these major divisions, there is a zone of strongly layered rocks with individual cumulate layers rich in pyroxene, calcium-rich plagioclase or chromite. This is the zone that is richest in chromite and platinum ores. At higher levels in the intrusion, there are layers of cumulate magnetite, important for their high vanadium content (grading 0.5–2% V₂O₅). The shape of the intrusion, and the presence of granite—formed from melted crustal material—overlying it in the middle, means that ore deposits