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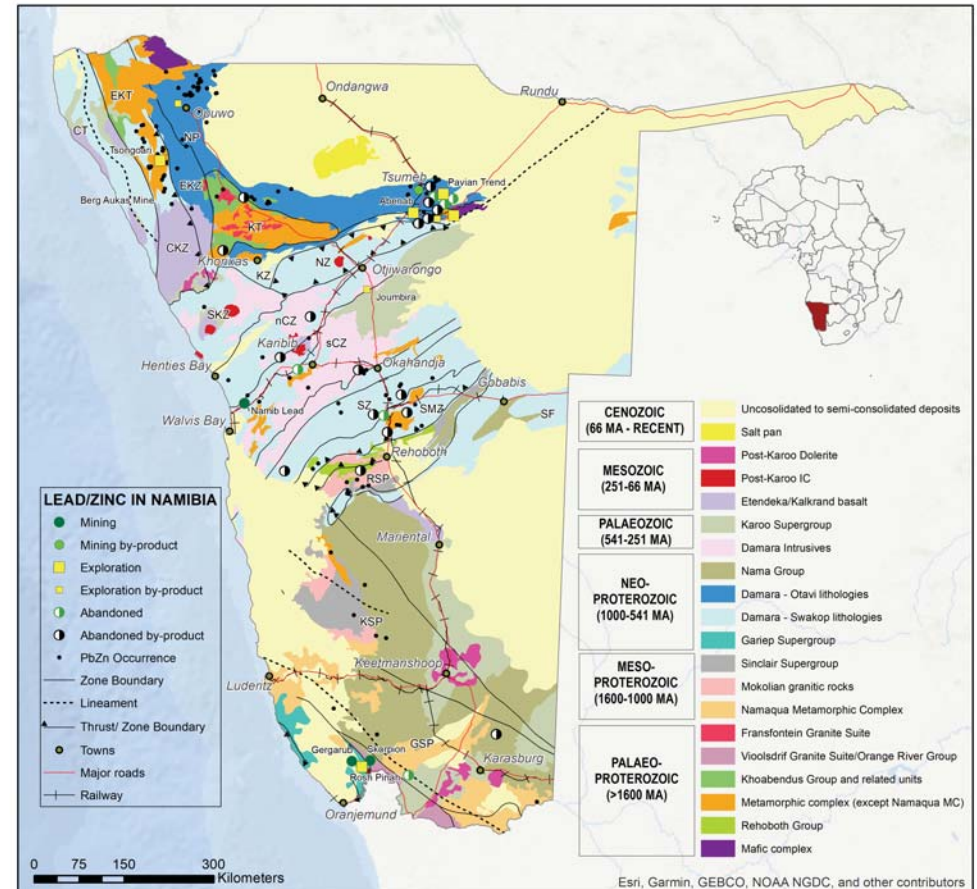


GEOLOGICAL SURVEY OF NAMIBIA



## Commodity & Host Geology

Most of the lead-zinc deposits in Namibia are located either within the Damara Sequence or its equivalents. The Otavi Mountainland in the Tsumeb area for instance hosts many abandoned mine projects with Mississippi Valley-type mineralisation hosted in carbonates (e.g. Tsumeb, Kombat etc.), some of which are currently being re-evaluated (e.g. Berg Aukas).



In western Namibia, lead and zinc deposits are found in marbles of the Karibib Formation (e.g. Namib Lead-Zinc), while the SEDEX/ besshi-type deposits associated with the Matchless amphibolite Belt in the vicinity of Windhoek feature lead and zinc as a by-product in former copper mines (e.g. Otjihase). Only few but very important deposits are situated in southern Namibia, as the volcano-sedimentary/volcanogenic massive sulphide deposits hosted in metasediments at Rosh Pinah and Skorpion Zinc. Common ore minerals can be found in the table.



## Historic mining in Namibia

Several mining operations recovered lead and zinc as a main or by-product in the past. The most important ones were Tsumeb Mine (1905-1996), Kombat Mine (1911-2007), Namib Lead Mine (1965-1992; to be re-opened) and to a smaller extent Otjihase Mine (zinc recovered between 1975-77), Abenab West Mine (1939-1958), Berg Aukas Mine (1925-28, 1957-78), and Ai-Ais Lead Mine (1912-1950s).

## Current Exploration and Mining Projects

Project	Status	Type	Ore minerals	Reserves	Resources
Namib Lead-Zinc	Re-opening, LOM 8 years	Stratabound structural traps, vein-hosted within marble and calc-silicates; sulfides	Galena, Sphalerite, marmatite	<b>Probable:</b> 611kt @ 6.6% Zn, 2.3% Pb, 49g/t Ag (source: Namib Lead & Zinc Mining)	<b>Fresh ore Indicated</b> 710kt @ 7% Zn, 2.4% Pb, 50g/t Ag <b>Inferred</b> 409kt @ 6% Zn, 2.2% Pb, 38g/t Ag <b>Tailings measured</b> 260kt @ 2.2% Zn, 0.3% Pb, 7.5g/t Ag <b>Indicated</b> 350kt @ 2.1% Zn, 0.3% Pb, 7.7g/t Ag (source: Namib Lead & Zinc Mining)
Rosh Pinah	Active since 1969; expected LOM until 2031  Production in 2018: 107.568 t Zn concentrate, 14.068 t Pb concentrate (source: Chamber of Mines Namibia)	Reworked SEDEX; sulfides	Chalcopyrite, Galena, Pyrite, Sphalerite	Proven: 3.9Mt @ 7.2% Zn, 1.59% Pb, 20.49g/t Ag AgnProbable: 4.59Mt @ 6.4% Zn, 1.46% Pb, 21.9 g/t Ag	Measured: 5.49Mt @ 8.33% Zn, 1.93% Pb, 27.14g/t Ag Indicated: 5.83Mt @ 7.3% Zn, 1.76% Pb, 25.16 g/t Ag Inferred: n5.56Mt @ 7.11% Zn, 1.13% Pb, 24.93g/t Ag
Skorpion Zinc	Active/hold LOM until 2020  Production in 2018: 65.993 t special high grade Zn (source: Chamber of Mines Namibia)	Volcano-sedimentary (VMS in weathered siliciclastics), Zinc-Oxide/carbonate/phosphate/silicate hosted in arkose and volcanic siliciclastics	Hemimorphite, Hydrozincite, Saucanite, Scholzite, Smithsonite, Tarbuttite	<b>Total pre-mining reserve and resources:</b> 26Mt @ 10% Zn, 0.13% Cu (source: Vedanta Zinc International)	

Gergarub	Exploration/reserves development (inactive)	SEDEX and synsedimentary VMS hosted in siliciclastics	Sphalerite, galena, chalcopryrite		<b>Indicated</b> 11.36Mt @ 9.13% Zn, 2.48% Pb, 43.39g/t Ag <b>Inferred</b> 6.72Mt @ 6.72% Zn, 2.17% Pb, 35.95g/t Ag (estimate from 2011, S&P Global)
Berg Aukas	Exploration, feasibility completed	MVT in dolomite/limestone/shale; carbonate, sulphide, silicate	Cerussite, Galena, Smithsonite, Sphalerite, Willemite	1.69Mt @ 11.16% Zn, 2.76% Pb, 0.23% V <sub>2</sub> O <sub>5</sub> (estimate from 2013, S&P Global)	<b>Measured &amp; indicated</b> 1.23Mt @ 15.47% Zn, 3.84% Pb, 0.33% V <sub>2</sub> O <sub>5</sub> (estimate from 2013, S&P Global)
Abenab	Advanced exploration, reserves development	Breccia pipes, brecciated carbonate rock; vanadate	Cerussite, Galena, Smithsonite, Sphalerite, Willemite, Vanadinite, Descloizite		Advanced exploration, reserves development
Tsongoari	Inactive, reserves development	SEDEX within marble, shist, conglomerate, quartzite, dolomite; mixed sulfide	Chalcopyrite, sphalerite, galena		<b>Indicated</b> 5.8Mt @ 0.8% Zn, 6.4% Pb, 47g/t Ag (estimate from 2004, S&P Global)
Pavian Trend	Prefeasibility/scoping, reserves development	Epigenetic vein hosted within dolomite (previously MVT); sulfide	Galena, Sphalerite		<b>Inferred</b> 17.66Mt @ 1.66% Zn, 0.54% Pb, 4.6 g/t Ag (estimate from 2014, S&P Global)
Joumbira	Exploration, target outline	Shallow metasomatic skarn; sulfide	To be defined. Drilling program	Joumbira	Exploration, target outline

Zinc and/or lead are also listed as a by-product in a few projects such as the Opuwo Cobalt Project (112.4Mt @ 0.43% Zn; pe-feasibility/scoping stage), at Tschudi Copper (Pb-grade not disclosed), at Kombat Mine (7.8Mt @ 1.07% Pb) and in Guchab Copper Project (exploration, target outline, Pb-Zn anomalies).

## Value addition in Namibia

The refinery at Skorpion Zinc produces special high grade zinc through electro-winning. In the past, the plant has also been used for zinc ore transported from mines in the Northern Cape, South Africa.

The historic Tsumeb Mine used to have a lead smelter and refinery. It was transformed into a copper smelter in recent times.