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A new Bi-rich variety of vesuvianite from Långban, Central Sweden

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A new Bi-rich variety of vesuvianite with up to 20 wt % Bi_2O_3 and occasionally in combination with enhanced lead contents up to *ca*. 5 wt % PbO is reported. The mineral occurs as small ($\leq$ 300 μm) euhedral, black coloured crystals in skarn from the Långban Mn-Fe deposit, central Sweden. The major skarn minerals comprise Ba-rich potassic feldspar, plagioclase ($Ab_{60}An_{40}$ - Ab_{100}), Pb-rich scapolite ($Me_{50}Ma_{50}$ – $Me_{60}Ma_{40}$) and phlogopite, while Pb-rich epidote, vesuvianite and calcic garnets are minor phases. Calcite, titanite, muscovite and zircon are accessory minerals.

The Långban deposit (59.86˚N, 14.27˚E) comprises stratabound Fe and Mn oxide-rich ore lenses with associated skarn bodies and mineralised veins and fissures hosted by metamorphosed carbonates and siliceous volcanics of early Proterozoic age ($\sim$1.85 Ga). The deposit is generally considered to be of syngenetic, submarine volcanic-exhalative origin. Together with related deposits in west-central Sweden, it is characterised by enhanced contents of As, Ba, Be, Pb and Sb. Reactions with pegmatitic fluids derived from younger granite intrusions subsequently introduced additional chemical components such as Be, F, Sn and W.

The skarn associated vesuvianite grains are strongly zoned displaying Bi-rich cores surrounded by narrow Bi-poor rims. Although generally high in bismuth, the crystal cores invariably show oscillatory zoning. Concentrations of Si and Al are lower while Fe and Ti contents are somewhat enhanced in the Bi-rich cores. In addition to high Bi- and Pb-contents, the crystals are occasionally enriched in copper, cerium, antimony and arsenic, thus reflecting the complex chemistry and evolution of the Långban mineralization.

Chemical analyses of vesuvianite crystals demonstrate a strong negative correlation between Ca and Bi, hence confirming that Bi replaces calcium at the X-sites of the structure. Maximum Bi and Pb contents analysed in the present vesuvianite crystals correspond to 3.12 and 0.87 atoms per formula unit, respectively. This exceeds by far previous reports in literature. Depending on the ordering of Bi among the four structural X sites, this vesuvianite variety may represent a new mineral species. Preliminary X-ray single-crystal diffraction studies determined the unit cell parameters for a representative crystal as a=15.794(1) Å and c=11.898(1) Å, but attempts to refine the crystal structure were unsuccessful due to poor crystal quality.