Magnetite from End-Permian Phreatomagmatic Pipes of the Tunguska Basin: A Comparison with Benchmark Chilean and Australian IOCG Deposits and Magnetite of the Bushveld Complex

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The magnetite ores in the south of Tunguska Basin (Siberia, Russia) were discovered in the mid-nineteenth century and were intensively prospected from the 1970s to the 1990s, but the origin of these deposits is still poorly understood. Intensive geological mapping and prospecting for iron ores at the south of Tunguska Basin revealed more than 300 subvertical brecciated pipes with magnesioferrite, magnetit,e and apatite mineralization. Many of these zones were previously described as basalt pipes (diatremes) filled with volcaniclastic deposits. More than 40 mineralized pipes are described as a part of the so-called Angara-Ilim type ore deposits, where six are large (>100 Mt of iron ores), 14 are medium sized (20–100 Mt) and 19 are small (<20 Mt). Three of them (Korshunovsk, Rudnogorsk, and Tatyaninsk) have been mined for decades and are still producing. All the other mineralized basalt pipes in the basin are of non-commercial grade and are underexplored. The geological setting where the ore-filled pipes is well constrained contains thick accumulations of halite and anhydrite-rich evaporite, likely linked to ore genesis.

Russian studies of these magnetite deposits are often out of date or focused on EMP data of magnetites from specific localities. Many geochemical classification diagrams have been suggested in the literature the past decade, based on techniques such as EMPA and LA-ICP-MS, and they span a wide range of magnetite deposits worldwide. However, data for magnetite from the mineralized basalt pipes in Siberia are still not included. We fill this gap by presenting ongoing work on magnetite from phreatomagmatic pipes of the Tunguska Basin and compare the results with well-known Australian (Woodland) and Chilean (El Laco) benchmark IOCG deposits as well as some magmatic magnetite of Bushveld Complex (South Africa). We show that similarities exist between deep-seated magnetites of the Angara-Ilim deposits and magnetite exsolutions from the Bushveld Complex. Moreover, late stage magnetites (veins and ores incrustation) of El Laco (Chile) and Angara-Ilim deposits have strong similarity in zonality and trace elements composition. Our results can be used to understand the genesis of IOCG ores in areas where basaltic magmas have interacted with evaporite-rich sedimentary rocks.