Montana – A Sapphire Anomaly

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Montana has produced at least 350 million carats (70 tonnes) of sapphires, but the four surrounding states and three provinces have had no significant production. Why?

Sapphire Deposits and Occurrence

Alluvial

Rock Creek sapphire district
Historic Production – 65 tonnes
Inferred bedrock source – Rhyolite flows
Age of bedrock source – 50.20 ± 0.43 Ma (Berg, 2014).

South Fork of Dry Cottonwood Creek and Butte area
Historic Production – Probably only 0.1-0.2 tonne
Bedrock source – Lowland Creek Volcanics (Berger and Berg, 2006 and Berg, 2007).

Missouri River deposits
Historic production – Probably greater than 4 tonnes
Bedrock source – Unknown, but probably dikes or sills
Age of bedrock source - Possibly Tertiary

Bedrock

Yogo Dike
Historic production – 3.6 tonnes (Michaluk, 1995)
Source – Quartzite dikes
Age – 48.66 ± 0.06 Ma (Harlan, 1996).

French Bar Sill
Historic production – Essentially none – Only sparse sapphire xenocrysts
Source – Basaltic trachyandesite
Age – 50.8 Ma (Irving and Heam, 2003)

Origin

Guliani and others (2015) have shown that δ18O values can be used to differentiate between magmatic and metamorphic sapphires. Sapphires from the Rock Creek district and the South Fork of Dry Cottonwood Creek have δ18O values less than 7‰, within the range of metamorphic sapphires (Berg and others, 2008). In addition mineral inclusions in sapphires from these districts are indicative of a metamorphic origin (Berg, 2007 and 2014).

Conclusions

1. Montana sapphires have been brought to the surface by Eocene volcanism.
2. The major Montana sapphire districts are related to the Paleoproterozoic accreted terrane and not the Archean Wyoming Craton. However non-gem corundum deposits occur in the Archean Wyoming Craton in southwestern Montana.

Speculation

Metamorphism in either the lower crust or lithospheric mantle of sediments in the accreted terrane produced corundum of the gem variety.

Problem

If Eocene volcanism and the accreted terrane were the only controls on the formation of sapphire deposits, there should be significant deposits in eastern Idaho. The accreted terrane extends into Idaho and there is abundant Eocene sapphire as evidenced by the Challis Volcanics. Apparently no significant sapphire deposits have been recognized in this area of Idaho. However sapphires occur in Adams and Valley Counties in western Idaho at Rocky Flat (Beckwith, 2003, p. 66-70). Gem-quality corundum reportedly occurs in the Grave Butte area in Idaho County (Eckert, 2000, p. 28).

References


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