Dating zircon inclusions in gem corundum deposits and genetic implications

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1. Introduction

Sapphires and rubies mined from placer deposits form an important economic gem resource. Many are xenocrysts from basaltic fields or from other sources. An age of corundum crystallisation indicates their lithospheric origin. Zircon is the main syngenetic inclusion used for U-Pb geochronology, although other minerals can be used. Many models exist for corundum formation under basalt fields, and dating of embedded inclusions helps to constrain these models. Most dating so far is from the Australian-Asian basaltic gem fields on the West Pacific margin, but includes other areas, e.g. Rio Mayo placers, Colombia, S. America (Figs. 1A & 1B). In this study we summarise known U-Pb zircon inclusion ages in corundums together with our new data from Mogok gemstone tract in Myanmar, to assess their genesis.

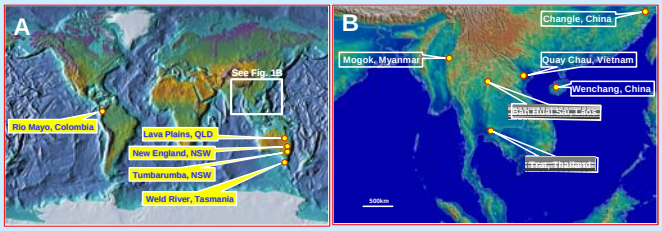

Figure 1. Map showing localities of U-Pb age of zircon in gem corundums compiled in this study.

2. Geochronology

The examples of the zircon inclusions in corundums are shown in Figs. 2 and 3. The gem corundum formation ages, from syngenetic zircon U/Pb ages are presented in Table 1: Weld River, Tasmania, magmatic sapphires (47 Ma), Tumbarumba, NSW, magmatic and metasomatic corundums (23 Ma, 23-48 Ma, 400 Ma), New England, NSW, magmatic corundums (33-53 Ma), Lava Plains, Qld, magmatic corundums (2.3-3.9 Ma), Khao Wau, Trat, Thailand, magmatic corundums (1-2 Ma), Ban Huai Sai, Laos, magmatic sapphires (1-2 Ma), Wenchang, China, magmatic corundums (4.7 Ma), Changle, China, magmatic corundums (16-17 Ma), Quay Chau, Vietnam, metamorphic-metasomatic rubies (54 Ma), Mogok, Myanmar, metamorphic-metasomatic rubies (31-32 Ma) and Rio Mayo, Colombia,metasomatic corundums (~10 Ma).

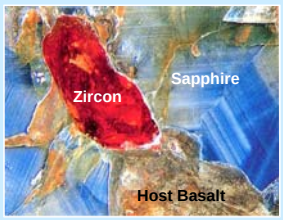

Figure 2. Zircon inclusion in sapphire from Lava Plains, McBride volcanic Province, North Queensland. The zircon gave a SHRIMP U-Pb age of 2.9 Ma. The zircon is about 2mm across in size. The evidence suggests this sapphire crystallised shortly before the main basaltic activity started in the McBride Province at 2.7 Ma, but was brought up in an eruption sometime after this. Photograph taken by G.B. Webb.

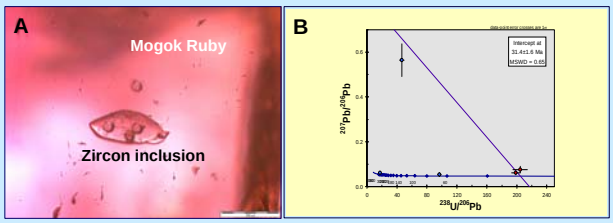

Figure 3A. Photomicrograph showing zircon inclusion in Mogok ruby, Myanmar. B. Concordia plot of Laser Ablation ICP-MS U-Pb zircon age (31-32 Ma) of the zircon inclusion in the ruby.

Table 1. Gem corundum formation ages, from syngenetic zircon U/Pb geochronology

Area	Ref	Corundum Type	Age (Ma)	Comments
Australia				
Weld River, Tas.	1	Magmatic	47 Ma	Local basalt age
Tumbarumba, NSW	2	Magmatic	23	Local basalt age
		Metasomatic	23-28	Also, 900 Ma core
		Metasomatic	400	Basement age
New England, NSW	3	Magmatic	36-38	Local basalt ages
Lava Plains, Qld	4,5	Magmatic	28-45	Local basalt ages
	5	Magmatic	2.3-3.9	Local basalt ages
Asia				
Trat, Thailand	6	Magmatic	1-2	Local basalt ages
Ban Huai Sai, Laos	7	Magmatic	1-2	Local basalt ages
Wenchang, China	4	Magmatic	4.7	Local basalt ages
Changle, China	4	Magmatic	16-17	Local basalt ages
Quay Chau, Vietnam	8	Metasomatic	54	Local foldbelt age
Mogok, Myanmar	9	Metasomatic	31-32	Local foldbelt age
South America				Local volcanics
Rio Mayo, Colombia	10	Metasomatic	~10	age ?

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4. Conclusions

• Most magmatic sapphire zircons give ages close to or within eruptive ages of the host basalt fields. Mostly Late Cenozoic to Palaeogene (1-53 Ma) ages are recorded. This suggests such sapphires formed from salic melts linked to basalt generation. Rubies from basaltic placers rarely contain zircon, so have more conjectural ages. They have metamorphic features and are linked to mafic granulites, so are probably older than accompany -ing magmatic sapphires.

• Rubies with zircon inclusions from marble host rocks are dated from Myanmar and Vietnam (31-54 Ma), but these differ in genesis to ruby xenocrysts from Asian basalt fields. A metasomatic sapphire/ruby suite from Colombia, South America is dated with ~10 Ma and may be linked to fluid activity during Andean volcanism.

Acknowledgements

This study is supported by CODES and Institutional Research Grant Scheme (IRGS), University of Tasmania, Australia. The authors are indebted to staff from CODES, University of Tasmania and Professors U Maung Thein and U Hla Kyi from Yangon University for fruitful discussions.