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MINERALOGICAL, TEXTURAL AND FLUID INCLUSION STUDIES OF CORUNDUM AND SPINEL IN SRI LANKA

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**DEPARTMENT OF EARTH RESOURCES ENGINEERING
OF THE UNIVERSITY OF MORATUWA**

***in partial fulfillment of the requirement
for the degree of***

DOCTOR OF PHILOSOPHY

of the

UNIVERSITY OF MORATUWA

SRI LANKA

May 2003

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To my Parents,

Whose lifelong ambition was to educate their children
to reach the pinnacle of their desired path

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DECLARATION

I do hereby declare that the work reported in this project report/ thesis was exclusively carried out by me under the supervision of Prof. P.G.R. Dharmaratne. It describes the results of my own independent research except where due references have been made in the text. No part of this project report/ thesis has been submitted earlier or concurrently for the same or any other degree.

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Name and signature of the supervisor ……………………………

Prof. P. G. R. Daharmaratne

Date : 26/02/2003

ACKNOWLEDGEMENTS

I wish to thank my supervisor, Prof. P.G.R. Dharmaratne, Professor of Earth Resources Engineering and Chairman, National Gem and Jewellery Authority, for his guidance to complete this task successfully and on schedule. I greatly appreciate the manner in which he monitored my work, allowing me to use my discretion in many instances and also providing a lot of samples for studies.

I am deeply indebted to Prof. Mrs. Niranjani Ratnayake, Director Postgraduate Studies for the support given throughout the period of this study.

I sincerely thank Dr. Kithsiri Dissanayaka, Head, Department of Earth Resources Engineering, for his help and constant encouragement.

I am very grateful to Mr. Dayananda Dillimuni, Visiting Lecturer, University of Moratuwa, for helping me to find relevant information and prepare the samples.

My most sincere thanks are due to Prof. Hiroharu Matsueda, Hokkaido University, Japan, for the analysis of fluid inclusions and Dr. Reto Giere , Associate Professor of Geochemistry, Purdue University, USA for Electron Microprobe Analysis.

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I wish to thank the academic and technical staff of the Department of Earth Resources Engineering, specially Mr. Harsha Waidyasekera, for their co-operation and assistance.

My most sincere thanks are due to all my friends who helped me in so many ways such as to collect samples from the study areas.

Financial assistance by the Asian development bank is gratefully acknowledged.

Last, but not least, I am grateful to my parents for their constant encouragement and blessings.

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ABSTRACT

Corundum and spinel are the most prominent gem minerals found in Sri Lanka that account for more than half its gem exports. Further, Sri Lanka is a major supplier of top quality sapphire.

The main objective of this study was to (i) identify as many properties as possible of Sri Lankan corundum and spinel, not recorded so far and (ii) list the properties supposed to be unique to certain terrains such as alkali magmatic terrains in other countries, which were helpful to understand the origin of corundum and spinel of Sri Lanka.

For this study samples representative of the Precambrian metasedimentary terrain of Sri Lanka were collected. For detailed investigations, samples from only Balangoda and Kaltota were chosen, because these areas were underlain by different gem-bearing source rocks.

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Several features unique to alkali magmatic terrains such as plagioclase crust around the crystal, surface features resembling needle - like patterns, radial cracks around zircon inclusions and inclusions of zircon clusters were observed in relation to Sri Lankan corundum.

Chemical fingerprinting, a methodology adopted to determine the origin of corundum, was carried out for a limited number of selected samples of which, two were identified as magmatic.

Several microscopic and macroscopic reaction textures provided evidence for the confirmation of metamorphic growth. These reactions were also confirmed by EPMA analysis.

Fluid inclusions representing the Precambrian rocks of Sri Lanka were scrutinized using petrological microscope, Raman microprobe and thermal stage microscope.

During this study it was possible to confirm the theory that Sri Lankan fluid inclusions contained more or less pure CO_2, and also the theory that the most common daughter minerals were graphite and diaspore. Necking too was observed and the process was similar to what was mostly observed in the corundum of Malawi.

A classification of corundum on the basis of fluid inclusions was formulated based on the shape, size and composition of fluid inclusions. The classification led to four categories.

Sapphirine too was found as an inclusion, in contact with spinel, in corundum. Hence it was possible to calculate the sapphirine/spinel thermometry. The calculation revealed that the crystallization temperature of Sri Lankan corundum was 761 ^{0}C (Fe^{2+} calculation).

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Finally the features unique to corundum found in other alkali magmatic terrains of the world, which are now identified in Sri Lanka too are taken into consideration. These features were plagioclase crust around corundum, surface features of needle-like pattern, zircon clusters and radial cracks around zircon inclusions in corundum. Two instances found by chemical fingerprinting to be of magmatic nature indicated the origin as such, while the reaction textures associated with the corundum bearing rock indicated metamorphic origin. These findings proved that the corundum of Sri Lanka displayed a combination of both magmatic and metamorphic properties. Hence the origin of corundum could not be attributed to metamorphism alone with certainty.

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LIST OF ABBREVIATIONS

PPL = Plane polarized light

CPL = Cross polarized light

AAS = Atomic absorption spectrophotometry

EPMA = Electron probe micro analyzer

XRMF = X-ray micro fluorescence

EDXRF = Energy dispersive x-ray fluorescence

WDS = Wavelength dispersive spectrometer

EDS = Energy dispersive spectrometer

SEM = Scanning electron microscope

NA = Not analyzed

GSMB = Geological Survey and Mines Bureau

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