EXECUTIVE SUMMARY

TITLE OF THE PROJECT:

'Petrological and Geochemical studies on the kimberlites of Timmasamudram kimberlite cluster, Wajrakarur kimberlite field, Eastern Dharwar craton, southern India'.

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i. Brief objective of the project:

The project was aimed on the studies of primary geochemical and petrological studies on four kimberlites of Timmasamudram kimberlite cluster of eastern Dharwar craton. Number of kimberlite occurrences are known from EDC, but Timmasamudram kimberlite bodies were recently discovered. Till date detailed geochemical and petrological studies of these kimberlites have not been undertaken. These bodies have potential to ascertain the nature and composition of sub continental lithospheric mantle in this part of EDC. Major and trace element data, along with detailed petrography is used to evaluate its petrogenesis and the nature of its source region. Apart from this their diamond potential can also be investigated solely based on the whole rock geochemistry.

ii. Summary of work done/ findings:

During the total duration (from 7/10/2010 to 30/06/2013) in this minor research project the detailed work done is given as follows,

1. The field work is carried out in two field seasons to study the geology of the area and for collection of samples from Timmasamudram and adjoining areas of Anantpur district and also from other kimberlite fields.

2. Representative samples were collected from all the kimberlite bodies for petrological studies and geochemical analysis.

3. The thin sections of all the samples were prepared and studied in Department of Geology, Institute of Science, Aurangabad, using high resolution polarizing microscope. The primary petrographic studies carried out on all the kimberlite pipes have confirmed the bodies as kimberlitic rocks.

4. The samples were powdered and subjected to geochemical analysis of major and trace elements. All the samples show major and trace element geochemistry similar to kimberlite rocks worldwide.

5. One abstract entitled 'Diamond prospectivity of newly discovered Timmasamudram kimberlites, Wajrakarur kimberlite field, eastern Dharwar craton, southern India: Constraints from whole rock geochemistry' published in National Conference on 'Recent advances and future challenges in geochemistry and geophysics: the Indian scenario' at BHU, Varanasi.

6. One paper entitled 'Petrogenesis of diamondiferous TK-4 kimberlite pipe, Wajrakarur kimberlite field, Eastern Dharwar craton, southern India: Constraints from whole rock geochemistry' has been presented and abstract published in national conference on 'Synergy of geochemistry, geology, geophysics towards natural and energy resources, environment and health' held during February 14 - 15, 2013 in Pune University, Pune.

7. The TK 1 pipe shows clear evidences of contamination by crustal material. Lower MgO in TK 1 pipe coupled with high SiO_2 content, positive Pb anomaly and higher HREE abundances than others on primitive mantle normalized diagrams and also lowest Ni content indicates significant role of crustal contamination in influencing the observed geochemical behavior of this pipe.

8. Combined mineralogy and whole rock compatible and incompatible elements and their ratios confirms that TK 4 pipe is showing marked affinity towards Behradih orangeite of Bastar craton and Group II kimberlites of Kaapvaal craton, South Africa, while TK 2 and 3 pipes shows similarities with Group I kimberlite of South Africa and other EDC kimberlites.

9. The modelling of trace elements shows that the melting of lherzolite source over range of 0.5-2% can produce the observed trace element and REE pattern of close to primary kimberlite magma in TK 4 kimberlite pipe.

10. The source of TK 4 close to primary kimberlite magma is enriched in LREE (La: ~10 x chondrite) and also in the highly incompatible LILE and HFSE elements (relative to primitive

mantle) and depleted in HREE (Lu: ~0.3 x chondrite) which indicates that lherzolite source had experienced a prior depletion event.

11. Incompatible trace element ratios of these pipes indicates enriched source similar to OIB and derivation from sub-continental lithospheric mantle. A two stage model is suggested where initial depletion of highly heterogeneous mantle, subsequently enriched by fluids derived from an upwelling mantle and thus introducing their geochemical signatures for the generation of Timmasamudram kimberlites.

12. TK 4 is richly diamondiferous while other three viz. TK 1, 2 and 3 are proved to be non diamondiferous by the processing of their bulk material. Therefore the presence of richly diamondiferous and non diamondiferous pipes in a single kimberlite cluster makes them unique and significant for showing applicability of whole rock geochemical model for testing diamond prospectivity in kimberlites in Indian context and to constrain on their source regions.

13. Our study shows that primitive mantle normalized multi-element profiles of the TK 4 kimberlite pipe are very similar to those of prospective kimberlites from worldwide, while other three pipes are showing more similarity towards non prospective pipes.

14. Lower whole rock Ti and Fe content of TK 4 kimberlite pipe, compared to other pipes also proves their prospective nature. Therefore this study validates the utility of bulk- rock geochemical models in rapidly assessing the diamond potential of kimberlites in Indian context.