Indian Placer Deposits
Indian Placer Deposits

Edited by
R. Dhana Raju
Dedicated, with reverence, to

(i) the late Dr. G. Prabhakar Rao, former Regional Director, AMD – a pioneer in the exploration and evaluation of the placer Heavy Mineral Sand deposits in India and whose team-work laid the foundation leading to the establishment of India’s major resource base of the Heavy Minerals in Mineral Sands and their industrial-scale utilisation;

(ii) the late Dr. K.M.V. Jayaram, former Deputy Director, AMD for his dynamic leadership in planning, evaluation and development of mineral technology for the recovery of the Rare Metal and Rare Earth (RM-RE) minerals to meet, indigenously, the major requirement of the RM-REs for the Indian nuclear programme; and

(iii) the Global Healthcare Personnel, who by their dedicated service, have both served and saved many lives, even with some sacrificing their own lives, during the Covid-19 pandemic, which has already taken > 3.5 million lives (Nature Briefings, June 07, 2021).

The Editor of and Contributors to the Volume, “Indian Placer Deposits”.

The syllable Aum has three phonetic components. ‘A’, ‘U’, ‘M’. It represents the three states of consciousness: waking state, dream state and sleep state.

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G.S. Ravi

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Placers, from the Spanish word “placer”, meaning “alluvial sand”, are economically important mechanical, secondary and detrital present or past accumulations/denudations of chemically resistant, stable, inert, hard, heavy minerals with specific gravity of > 2.89. They are: (i) separated from the light minerals by weathering and erosion of diverse geologic source materials; (ii) transported by moving water and/or air, based on natural gravity; and (iii) deposited for a profit in an aquatic and aeolian regime. They have been mined since the metals were first used by humanity and, hence, many of their features and evaluation have been known for a few centuries. The list of minerals that can be concentrated in placers contains approximately 40 species, including 30 minerals that can make up placer deposits. These deposits are mostly of the Phanerozoic age and rarely of older ages, with the latter being designated as “Palaeo-Placers”. The known placers are formed predominantly in the Cenozoic, derived from the Mesozoic and older primary mineralisation, disseminations, regional background levels and lithified intermediate sources. They occur worldwide at all elevations and at most latitudes, though the majority is generally confined to the tropical and subtropical belts. As a consequence, economically important placer deposits occur in Australia, India, Brazil, Sri Lanka, Malaysia, Thailand, Myanmar, Vietnam, Mozambique, Sierra Leone, Madagascar, South Africa and the south-east USA. These deposits host many diverse precious, semi-precious, industrial and high-tech heavy minerals and metals, which include gold, platinum and other gemstones, magnetite, ilmenite, rutile, zircon, monazite, xenotime, chromite, cassiterite, columbite-tantalite, sillimanite, garnet etc. Historically, placers have yielded a very significant part of the world’s total supply of gold, platinum, tin and diamonds. They are presently the source of most of the world’s titanium. Compared to the primary metallic deposits, such as ferrous, non-ferrous, base metals and precious metals as well as non-metallic deposits, such as coal, limestone, phosphate and barite, the placer deposits have the following unique attributes: (i) wide spectrum of mineralisation, which includes precious, semi-precious, industrial, strategic and critical minerals, required for the ornamental, conventional, high-tech and cutting-edge technologies-based industries; (ii) easy and less costly to mine, mostly by surface and open-pit mining, as they occur at very shallow depth either at surface or near-
surface, in contrast to the deep-seated many primary deposits; (iii) occurrence during a long geological period of the Archaean (palaeo-placers) to Recent/ Present at all elevations and most latitudes; (iv) diverse controls, such as the source rock geology, disintegration of minerals, resistance to weathering, transportation media, gradient, density difference, favourable locales, geomorphology, different environments of lacustrine, fluvial, beach, dune, marginal marine, marine and glacial; waves and long-shore currents; and (v) the cost of placer minerals and their metals ranging widely from a few hundred dollars per ton (e.g., ilmenite, sillimanite and garnet) to a few thousand dollars per ounce (31.1 g of gold) and carat (200 mg of diamond).

At the invitation of the Cambridge Scholars Publishing, the UK, the undersigned has selected the topic of ‘Indian Placer Deposits’ for the present edit volume, in view of many notable attributes of the placers, cited above, and the occurrence of diverse types of placer deposits/prospects in India, such as the gold, diamond and other gemstones, tin, rare metals, rare earths and the vast heavy mineral sands. For this, he has invited some of his former colleagues in the AMD and a few other geo-scientists, each having an expertise in their respective fields of specialisation for nearly three decades, resulting in the present volume that comprises their and the undersigned’s contributory chapters on the Indian placer deposits.

In this volume, Dhana Raju presents in (i) Chapter 1, an overview of the placers of gold, platinum, diamond and other gemstones, tin, rare metals, rare earths and heavy mineral sand (HMS) deposits, encompassing the historical-economic aspects of placers, their provenance rocks, exploration, mining and post-mining operations; and (ii) Chapter 11, the mineral processing of HM deposits with many flow-sheets for separation, concentration, purification and extraction of both the individual placer HMs and their contained valuable metals, together with different processes to obtain their value-added products. In Chapter 2, Prabhakar Sangurmath deals with the primary, supergene lateritic and placer gold occurrences, prospects and 42 micro-mines opened up by the ancient/ modern artisanal miners over an area of ~ 1200 sq. km in the Wayanad–Nilambur sector within the granulitic terrain of SW India; these have been known since over two centuries, and are the earliest ones explored for gold in India. In Chapter 3, Satyanarayana et al., present an account of the India’s inland diamond placer and primary deposits/occurrences, their source-host-rocks, geology, geomorphology, distribution, exploration,
mining and processing at Majhgawan, the country’s only plant for diamonds, and resources, besides India’s pre-eminent position in the world from the pre-historic times for diamonds and their trading as also some world-famous diamonds such as the Koh-i-Noor. Ramesh Babu presents in (i) Chapter 4, a detailed account of the eluvial, deluvial, colluvial and alluvial Rare Metal (RMs: Nb-Ta, Be, Li and Cs) placer deposits, associated with the primary mineralised source rocks – zoned RMRE granite pegmatites and their replacement zones – in three major pegmatite belts, viz., (a) the Bastar–Malkangiri Pegmatite Belt (BMPB) in the states of Chhattisgarh and Odisha, (b) the Jharsuguda district in north Odisha and (c) the Holenarsipur and Nagamangala schist belts in the state of Karnataka, together with their geology, exploration, RM- and Sn-mineralogy (columbite-tantalite, beryl, spodumene, lepidolite and amblygonite, and cassiterite), mineral chemistry, resources and mineral processing for the up-gradation, concentration and recovery of RM minerals in the field-based mobile recovery plants; and (ii) Chapter 5, an account of HREE and LREE riverine, small placer deposits, respectively, in the form of xenotime and monazite, derived from the intrusive granites and pegmatites in the Chhotanagpur Granite Gneiss Complex region in parts of the states of Chhattisgarh and Jharkhand, along with their geology, exploration, mineralogy, chemistry of RE-minerals and their concentrates, evaluation and mineral processing for recovery, concentration and up-gradation of the RE-minerals. In Chapter 6, Palanivel et al., present some of the advanced methods of geo-informatics used to probe the lithology, structure, geomorphology and location of the placer HMS deposits, taking those in the state of Kerala as a case-study. In Chapter 7, Chandrasekaran, Balachandran and Murugan present the information and data on the beach placer heavy mineral sand deposits of Kerala, in terms of their geology, geomorphology, structure, evolution, areal extent, exploration, evaluation, mineralogy, grade, grain-size, chemical characters, resources, mining, production, value-addition and the lake-bed and offshore resources etc. In Chapter 8, Chandrasekaran and Murugan document the shoreline, fluvial and inland red sands (Teris) placer HMS deposits in the state of Tamil Nadu, covering the aspects of geomorphology, geology, exploration, evaluation of the beach and dune HMS deposits, Teri sand deposits and fluvial HMS occurrences, their mining, HM resources, mineralogy and mineral chemistry of ilmenite, mineral beneficiation, production and value-added products. Ravi presents in (i) Chapter 9, the shoreline HMS deposits in the state of Andhra Pradesh, covering aspects of the geology, influence of hinterland geology and geomorphology on the HM-grade, exploration, evaluation, resources,
reserves, sedimentological parameters, mineralogy and mineral chemistry of HMs, offshore HMS occurrences, down-stream industry with value-addition, economic prognosis, environmental concerns and refilling-recycling-reclamation-reuse (R-4) of the mined areas; and (ii) Chapter 10, the shoreline and inland HMS deposits/potential occurrences in the state of Odisha, covering the aspects of regional geology, provenance rocks, geomorphology, structure, tectonics, exploration, and resource evaluation of HMs in the major deposits and potential occurrences, together with salient aspects of the mineralogy, textures, sedimentology, EMP-based mineral chemistry of HMs and a brief account on the offshore HM resources and the environmental constraints in the study-area.

Lastly, the editor will be grateful if any omissions and commissions in the volume are brought to his notice, so that the same will be attended to in its subsequent editions.

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ACKNOWLEDGEMENTS

My sincere thanks are due to:

- The authors of all papers and other publications, from different academic institutes and organizations/companies of the mineral industry, which are cited in the text, figures and tables, and listed under the ‘Bibliography’ for their data and information, without which this volume could have never been possible;
- “Google Search” and “ResearchGate”, which helped in tracing the relevant papers on the topic of “placer deposits”;
- My all ‘Co-Contributing Subject-Specialists’ of the volume for their completion of the chapters, almost in time, in spite the Covid-19 pandemic in 2020 and 2021, and its effect on personal health;
- My former colleagues in the Atomic Minerals Directorate (AMD) for Exploration and Research, Department of Atomic Energy, Govt. of India and Dr. B. Srinivas of the Dept. of Applied Geochemistry, Osmania University, Hyderabad, India for their continuous support;
- Mr. K. Jagannadha Rao and Mr. J. Srikanth for their help in preparing/modifying and formatting a few figures and folders;
- Mrs. Helen Edwards, Mrs. Rebecca Gladders, Mrs. Sophie Edminson and others of Cambridge Scholars Publishing (CSP), Lady Stephenson Library, Newcastle upon Tyne, NE6 2PA, the U.K. for their invitation and approval of my project for this edited volume as well as for its processing and publishing;
- The CSP for their contribution to meet partly the proof-reading cost of the draft-manuscripts of eleven chapters;
- Dr. John E. Jacobs for timely proof-reading of the manuscripts;
- My wife, Mrs. R. Manikyamba and our family members – Venkat Ram, Lokeshwar, Srinivas Rao, Lakshmi Prabha, Krishnaveni, Seeta Mahalakshmi, Naren, Sneha, Jaya Kalyan and Sishir Dev for their support at home; and
- Above all, the Almighty, my teachers, mentors and well-wishers for Their Blessings.

R. Dhana Raju
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