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Preface

The Gondwana flora, that occupied the southern continent Gondwana when South America, South Africa, India, Antarctica and Australia were joined together in one landmass, has been the subject of extensive investigations both in Brazil and India. Substantial studies were conducted in isolation and the researchers of the two countries generated a sizeable and comprehensive knowledge base on mega and microfossils of Gondwana. However, there was a pining for a joint and comparative morphological, evolutionary, stratigraphical, palaeoecological and palaeobiological inquiry and consolidation of the generated knowledge by the researchers. Therefore, need for a collaborative research work on the Gondwana flora from different sedimentary basins of India and Brazil was strongly felt.

Initial contacts were established between Prof. Mary Elizabeth C. Bernardes de Oliveira, Professor, Palaeontology Division, University of Guarulhos, São Paulo and University of São Paulo, São Paulo, Brazil and Dr N.C. Mehrotra, Director, Birbal Sahni Institute of Palaeobotany (BSIP), Lucknow, India for integrating the Gondwana researches of the two countries in a collaborative project mode to understand and fill the knowledge gaps. The idea was conceived in the year 2007 in Buzios, Brazil, during XX Congress of Palaeontology. It took two years for the joint project to materialize. Finally, in the year 2009, it was approved and funded by the Department of Science and Technology (DST), New Delhi, India and Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) - "National Counsel of Technological and Scientific Development", Brazil. The principal objective of the proposal, besides the comparative study of the Gondwana flora of India and Brazil, was to evolve a unique scientific collaboration between the two countries for the first time with far reaching repercussions and spin off benefits. Now that the project is successfully completed, the new knowledge generated and its integration has been useful in interpretation of biostratigraphy, evolution, palaeobiogeography and palaeoclimatology. The significance of the study increases due to the fact that the Gondwana flora of these two countries is responsible for the formation of the energy bioresource coal.

During the project meeting in Brazil, in the year 2010, an idea to hold an Indo- Brazilian Symposium in both the countries was conceived. The Symposium was envisaged as a melting pot of concepts and ideas highlighting the significant contributions of Gondwana researches of both the countries. The first Symposium in the series entitled "Indo- Brazilian Symposium on Glimpses of Gondwana Research" was organized by BSIP on 24 November, 2010 at Lucknow. The Symposium was an intensively focused event with an enthusiastic participation by several Brazilian and Indian Gondwana researchers. Fifteen scientific presentations were made on palaeofloristics of different sedimentary basins of India and Brazil including megaflora, mioflora, dinoflagellate cysts, stromatolites, insect–plant relationship, position of India in Gondwana reconstruction, and floral successions of Carboniferous-Permian interval of Brazil and their comparison with India. The Symposium provided a deep insight into the palaeobotanical studies being carried out in the two countries.

As a sequel to the first Symposium held in India, a second meeting of the "Indo-Brazilian Symposium on Glimpses of Gondwana Research" was organized on October 27, 2011 at Natal, Brazil as a special session in XXII Brazilian Congress of Palaeontology (23-28 October, 2011).

The current issue of "The Palaeobotanist" comprises peer reviewed research papers mainly as an outcome of the collaborative investigations carried out between Indian and Brazilian earth scientists under a joint project entitled "Palaeobotanical studies on Indian and Brazilian sedimentary basins with special reference to marine dinoflagellate cysts, Gondwana flora and their applications". In addition, the issue also includes papers of other researchers from both the countries on the core theme of the Symposium held at BSIP. The issue includes fourteen papers presented during the "Indo-Brazilian Symposium on Glimpses of Gondwana Research". Some of the

contributions are significant for their first endeavour on comparative biotic studies of Indian and Brazilian Gondwana, for example, a paper on "Stratigraphic ranges of dinoflagellate cysts from Cretaceous petroliferous basins of India and Brazil" analyses stratigraphic ranges of significant dinoflagellate taxa from the two countries in the global context and presents the result through six range tables. This is the first step to build comparative database of these fossils from India and Brazil for obtaining a better understanding of their distribution and application in the petroleum industry. Another paper on "Palaeobotanical evidence of wildfire in the Upper Permian of India: Macroscopic charcoal remains from the Raniganj Formation, Damodar Basin" records the charcoalified remains from the Raniganj Formation, Raniganj Coalfield suggesting occurrence of palaeo-wildfire for the first time in India. A research paper on "Pennsylvanian megaspores from northeastern border of the Paraná Basin, Brazil: Correlation with Indian Gondwana megaspores" is the first attempt on the comparative megaspore studies of India and Brazil. The presence of some of the megaspores, both in India and Brazil indicates the occurrence of common ancestral heterosporous early land plants. An attempt has been made to interpret the palaeogeographic distribution pattern of some of the megaspores, which appear earlier in Brazil than in India, suggesting the floral migration from Brazil towards India**.** Similarly, comparative palynological studies have been attempted through a paper entitled "Palynostratigraphic considerations on the Pennsylvanian interglacial microflora from Monte Mor (SP), Itararé Group, NE, Paraná Basin (Brazil) and its diachronic correlations with Indian Gondwana microflora".

Language plays an important role in exchange of ideas and dissemination of knowledge. Since both the collaborating countries have strong native languages, the abstracts of all the research papers have been translated into both Portuguese and Hindi languages – a first for "The Palaeobotanist". We are thankful to Ms Isaura Alves Da Silva Mendes and Mr Ashok Kumar for the translation of the abstracts in Portuguese and Hindi, respectively.

The project could not have seen the light of the day without the financial support of DST, India and the CNPq, Brazil. Their assistance and funding is thankfully acknowledged. Sincere thanks are due to the authors for their enthusiasm and timely contributions.

We gratefully acknowledge the reviewers for critically and objectively examining the manuscripts and offering valuable suggestions. Untiring efforts of the members of the Publication Unit Mr Rattan Lal Mehra and Mr Syed Rashid Ali are acknowledged for the timely publication of the issue.

N.C. Mehrotra
Rajni Tewari

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I, Naresh C. Mehrotra, hereby declare that the particulars given above are true to the best of my knowledge and belief.

N.C. Mehrotra

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(Naresh C. Mehrotra)

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Editorial Policy—The Palaeobotanist is published in two numbers per volume every year and issued in March and September. It publishes original articles on all aspects of palaeobotany and biostratigraphy including comments on previous articles, replies, palaeontological and taxonomic notes, and research communications of regional and international interest. All plant groups and aspects of botany having bearing on palaeobotany including plant micro- and mega-fossils, and plant-animal relationship are published. Some issues of the Journal will be devoted to a single theme. We also encourage monographic work. Besides, papers dealing with academic and applied aspects of palaeobotany as well as papers solving diverse geological problems which generate interest for palaeobotany among broad spectrum of readers are welcome.

Authors submitting a manuscript must ensure that it has not been submitted elsewhere and if it is accepted for publication, the copyright of the article will be transferred to the Birbal Sahni Institute of Palaeobotany, Lucknow, India. All the submitted manuscripts are subject to peer review, a process that is the responsibility of the editorial board.

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Acknowledgements—Provide initials of the persons without titles who are acknowledging.

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Pennsylvanian megaspores from northeastern border of the Paraná Basin, Brazil: Correlation with Indian Gondwana megaspores

SANDRA EIKO MUNE[1], RAJNI TEWARI[2*] AND MARY E.C. BERNARDES-DE-OLIVEIRA[1, 3]

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ABSTRACT

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Analysis of sediments from Campinas and Monte Mor, municipalities of the State of São Paulo, Brazil, has revealed the presence of new megaspores in addition to the known taxa. Trilete, alete, azonate and gulate dispersed fossil megaspores were recorded from the lower and middle levels of the Itararé Group from the northeastern border of the Paraná Basin (Lower Pennsylvanian) of Campinas municipality (Upper Bashkirian-Lower Moscovian) and of Monte Mor municipality (Kazimovian). Twenty-four species of megaspores recovered from one or both of these localities have been systematically analyzed and the synonymy of four previously described megaspores has been discussed.

The present study of megaspores from Campinas reveals the presence of the taxa *Banksisporites dijkstrae*, *B. endosporitiferus*, *B. utkalensis*, *Biharisporites spinosus*, *Bokarosporites psilatus*, *B. rotundus*, *Duosporites perversus*, *Duosporites* sp. a, *Lagenicula horrida*, *Lagenicula* sp., *L. nudus*, *L. rugosus*, *Lagenoisporites* cf. *L. hispanicus* and *Lagenoisporites*. sp. The megaspores from Monte Mor includes the taxa *Bokarosporites rotundus*, *Duosporites* sp. b, *Lagenoisporites nudus*, *L rugosus* and *L.* cf. *L. hispanicus*. The taxa *Bokarosporites rotundus*, *B. psilatus*, *Banksisporites utkalensis*, *B. endosporitiferus*, *B. dijkstrae* and *Biharisporites spinosus* are also known from the Permian of India. *Banksisporites tenuis* previously detected in Campinas and Monte Mor localities is also a species which is shared with India**.** The presence of these taxa in the Pennsylvanian of the Paraná Basin, Brazil indicates their appearance in the Carboniferous. While all of them persisted up to the Permian, some like *Biharisporites spinosus*, *Banksisporites tenuis* and *B. utkalensis* extend up to Triassic and Early Cretaceous as well. The presence of these megaspores both in India and in Brazil indicates the occurrence of common ancestral heterosporous early land plants. An attempt has been made to interpret the palaeogeographic distribution pattern of some of the megaspores which appeared earlier in Brazil as compared to India, suggesting the floral migration from Brazil towards India.

Key-words—Megaspores, Pennsylvanian, Paraná Basin, Permian, Palaeogeographic distribution, Brazil, India.

परान द्रोणी, ब्राज़ील की पूर्वोत्तर सीमा से प्राप्त पेन्नसीलवेनियाई स्थूलबीजाणुः भारतीय गोंडवाना स्थूलबीजाणुओं के साथ सहसंबंध

सांद्रा ईको मुने, रजनी तिवारी एवं मैरी ई सी बर्नान्डीज-डी-ऑलीवीरा

सारांश

साओ पॉलो, ब्राज़ील के राज्य की कैंपीनस एवं मांटे मोर नगर पालिकाओं से अवसादों के विश्लेषण सेज्ञात टैक्सा के अतिरिक्त नवीन स्थूलबीजाणु प्ररुपों का पता चला है। कैंपीनस नगरपालिका (ऊपरी बशकिरियाई निचले मास्कोवियाई) व मांटे मोर नगरपालिका (काज़ीमोवियाई) की पराना द्रोणी (निचले पेन्नसीलवेनियाई) की पूर्वोत्तर सीमा से प्राप्त इतारैर समूह के निचले व मध्य स्तरों से त्रिअरीय, अरहीन एज़ोट एवं गुलेट परिक्षिप्त स्थूलबीजाणु अभिलिखित किए गए थे। इनमें से एक या दोनों उपबस्तियों से प्राप्त किए गए स्थूलबीजाणुओं की चौबीस जातियां क्रमबद्ध रुप से विश्लेषित की गई हैं तथा पूर्व में वर्णित चार स्थूल बीजाणुओं की समानार्थकता पर विचार-विमर्श किया गया है।

कैंपीनस से प्राप्त स्थूलबीजाणुओं का मौजूदा अध्ययन *बैंकसीस्पोराइटिस डिक्स्ट्री, बी. एंडोस्पोराईटीफेरस, वी. उत्कलेन्सिस, बिहारीस्पोराइटिस स्पिनोसस, बोकारोस्पोराइटिस सिलेटस, बी. रोटंडस, ड्योस्पोराइटिस पर्वेरसस, ड्योस्पोराइटिस जाति ए, लगेनीकुला हॉर्रीडा, लगेनीकुला* जाति, *एल. नुडस, ऱ्युगोसस, लगेनोइस्पोराइटिस* तुल्य, *एल. हिस्पेनीकस* एवं *लगेनोइस्पोराइटिस* जाति टेक्सा की मौजूदगी बयां करता है। मांटे मोर से प्राप्त स्थूलबीजाणु में *बोकारोस्पोराइटिस रोटंडस, ड्योस्पोराइटिस जाति बी, लगेनोइस्पोराइटिस न्युडस, एल. रुगोसस, एल.* तुल्य *एल. हिस्पेनीकस* सन्निहित है। *बोकारोस्पोराइटिस रोटंडस, बी. सिलेटस, बैंकसीस्पोराइटिस उत्कलेन्सिस, बी. एंडोस्पोरिटिफेरस, वी. डिक्स्ट्री व बिहारीस्पोराइटिस स्पिनोसस टैक्सा* भारत के पर्मियन से भी ज्ञात हैं। कैंपीनस एवं मांटे मोर उपबस्तियों में पूर्व में पाई गई *वैंकसीस्पोराइटिस टेन्युइस* जाति भी भारत का अंश है। पराना द्रोणी के पेन्नीसिलवेनियन में इन टैक्सा की विद्यमानता कार्बोनिफेरस में उनके रुप इंगित करती हैं जब कि ये समस्त पर्मियन तक निरंतर रहे, तथा *बिहारीस्पोराइटिस स्पिनोसस, बैंकसीस्पोराइटिस टेन्युइस* एवं *बी. उत्कलेन्सिस* ट्राइऐसिक व प्रारंभिक क्रिटेशियस तक विस्तीर्ण रहे। भारत व ब्राज़ील दोनों में इन स्थूलबीजाणुओंकीविद्यमानता सामान्य मूल विषमबीजाणु की प्रारंभिक स्थलीय पेड़-पौधे इंगित करती है। ब्राज़ील से भारत की ओर वनस्पति-जात अभिगमन सुझाते हुए कुछेक स्थूलबीजाणुओं के पुराभौगोलिक वितरण प्ररुप की व्याख्या करने का प्रयास किया गया है जो पहले ब्राज़ील में तदोपरांत भारत में दिखे।

संकेत-शब्द—स्थूलबीजाणु, पेन्नसीलवेनियाई, पराना द्रोणी, पर्मियन, पुराभौगोलिक वितरण, ब्राज़ील, भारत।

Megáspores Pensilvanianos da margem nordeste da bacia do Paraná, Brasil: Correlação com megásporos Gondvânicos Indianos

RESUMO

Análises dos sedimentos de Campinas e Monte-Mor municípios do estado de São Paulo, Brasil, revelaram a presença de novos megásporos além dos taxa já conhecidos. megaspores fósseis dispersos tipo Trilete, alete azonate e gulate foram oservados a partir dos níveis inferiores e médios do Grupo Itararé da margem nordeste da Bacia do Paraná (Pensilvaniano inferior) do município de Campinas (Bashkiriano Superior e Moscoviano Inferior) e do município de Monte Mor (Kazimoviano). Vinte e quatro espécies de megásporos recuperados de uma ou ambas as localidades foram sistematicamente analisadas e as sinonímias de quatro megásporos descritos anteriormente tem sido objeto de discussão.

O presente estudo dos megásporos de Campinas revela a presença dos taxa *Banksisporites dijkstrae*, *B. endosporitiferous*, *B. utkalensis*, *Biharisporites spinosus*, *Bokarosporites psilatus*, *B. rotundus*, *Duosporites perversus*, *Duosporites* sp. a, *Lagenicula horrida*, *Lagenicula* sp. , *L. nudus*, *L. rugosus*, *Lagenoisporites cf. L. hispanicus* e *Lagenoisporites*. sp. Os megásporos de Monte Mor incluem os taxa *Bokarosporites rotundus*, *Duosporites* sp. b, *Lagenoisporites nudus*, *L rugosus*, *L.cf. L. hispanicus*,. O taxon *Bokarosporites rotundus*, *B. psilatus*, *Banksisporites utkalensis*, *B. endosporitiferous*, *B. dijkstrae* and *Biharisporites spinosus* são também conhecidos do Permiano da India; *Bankisisporites tenuis* previamente detectado nas localidades de Campinas and Monte Mor é também uma espécie compartilhada com a Índia. A presença destes taxons no Pensilvaniano da Bacia do Paraná, Brasil indica o seu aparecimento no Carbonífero e, embora todas elas persistiram até o Permiano, alguns como *Biharisporites spinosus, tenuis Banksisporites e utkalensis B*. estenderam-se até o Triássico e o eocretáceo também. A presença destes megásporos tanto na Índia quanto no Brasil indica a ocorrência de plantas terrestres primitivas heterósporas ancestrais comuns. Esforços tem sido feitos para interpretar o padrão de distribuição paleogeográfica de alguns dos megásporos que aparecem mais cedo no Brasil do que na Índia, sugerindo a migração da flora do Brasil para lá.

Palavras-chave—Megásporos, Pensilvaniano, bacia do Paraná, permiano, distribuição palaeogeográfica, Brasil, India.

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Upper Pennsylvanian lycopsids from interglacial taphoflora of Itararé Group, Paraná Basin, Brazil

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ABSTRACT

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The Pennsylvanian strata of the Itararé Group are present on the northeastern border of the Paraná Basin, i.e. northern part of Paraná State towards north of São Paulo. The Pennsylvanian lycopods of the Itararé Group are represented by diverse megafossils, megaspores and microspores. The present study deals with the lycopsid megafossils from the third interglacial level of the paleofloristic succession of the Itararé Group in the northeastern border of the Paraná Basin, i.e. *Paranocladus-Ginkgophyllum-Brasilodendron* association (PGB as.) recovered from its type locality Volpe ranch, in Monte Mor municipality, SP. The megafossils belong to the taxa *Bumbudendron millani, Bumbudendron* cf. *B. paganzianum, Brasilodendron pedroanum, Brasilodendron* sp., *Leptophloeum* cf. *L. sanctae-helenae,* and *Cyclodendron* sp. The diversity and abundance of the megafossils (sometimes forming coal beds in a glacial context) indicates climatic ameliorations of an interglacial phase of the "time Itararé". They represent paleoecological hydro-hygrophyllous communities of a fluviatile-lacustrine depositional environment. The biostratigraphical distribution of these taxa and their association with *Paranocladus, Ginkgophyllum* and *Buriadia* suggests a paleofloristic correlation with the *Krauselcladus - Asterotheca* Phytozone of northwestern Argentinean paleofloristic zonation. The lycophytic megaspores recorded earlier from this level suggest a diachronic correlation with the Permian Talchir and Karharbari associations of Indian Gondwanan flora. Comparison with late Paleozoic lycopsids and associated megaspores of Argentina and India are in consonance with the modern studies aiming to achieve knowledge of Gondwana biostratigraphy in a wider perspective.

Key-words—Kasimovian-Gzhelian, Lycopods, Brazilian Gondwana, Monte Mor (SP), PGB Association.

इतारैर समूह, पराना द्रोणी, ब्राज़ील के अंतःहिमानी टेफोफ्लोरा से प्राप्त ऊपरी पैन्सील्वेनियाई लाइकोप्सिड

सांद्रा ईको मुने, मैरी ई.सी. बर्नान्डीज-डी-ऑलीवीरा एवं रजनी तिवारी

सारांश

इतारैर समूह पैन्सील्वेनियाई पट्टीदार केवल पराना द्रोणी उत्तरपूर्वी सीमा, पराना राज्य के उत्तरी भाग, उत्तर की ओर से साओ पॉलो राज्य में विद्यमान हैं। इतारैर समूह के पैन्सील्वेनियाई लाइकोपॉड विभिन्न स्थूलजीवाश्मों, स्थूलबीजाणुओं एवं सूक्ष्मबीजाणुओं से रुपायित हैं। मौजूदा अध्ययन का पराना द्रोणी अर्थात मांटे मॉर नगर पालिका, एस पी में इसी तरह की उपबस्ती वॉल्पे रंच से प्राप्त *पैरनोक्लैडस-गिंकगोफिल्लम-ब्रसिलोडेंड्रान संघ (पी जी बी)* की उत्तरपूर्वी सीमा में इतारैर समूह के पुरापादप अनुक्रम के तृतीय अंतः हिमानी से प्राप्त लाइकोप्सिड स्थूलजीवाश्मों से संबंधित है। स्थूलजीवाश्म *बंबुडेड्रॉन मिलैनाई, बी.* तुल्य *बी. पगैन्ज़ियैनम, ब्रसिलोडेंड्रॉन पैड्रोएनम, एफ. ब्रसिलोडेंड्रान* जाति, *लेप्टोफ्लोलियम* तुल्य *एल. संकटे-हेलेने* और *सायक्लोडंड्रान* जाति टैक्सा के हैं। स्थूलजीवाश्मों की विविधता एवं बहुलता (हिमानी परिप्रेक्ष्य में कभी कोयला संस्तर गठित) "इतारैर काल" की अंतः हिमानी प्रावस्था के जलवायविक सुधार इंगित करती हैं। वे नदीय-सरोवरी निक्षेपणीय पर्यावरण का जल-आर्द्रताफायल्लस समुदाय रुपायित करते हैं। इन टैक्साओं के जैव स्तरिक वितरण एवं उनकी *पैरनोक्लैडस, गिंकगोफिल्लम व बुरिआडिया* के साथ

उनकी बंधुता उत्तरपश्चिमी अर्जेंटियाई पुरापादप अनुक्षेत्र के *क्रॉसेल्क्लेडस-एस्टेरोथेका* पादपमंडल के संग पुरापादप सहसंबंध सुझाती है। इस स्तर से पूर्व में अभिलिखित लाइकोफाइटी स्थूलबीजाणु भारतीय गोंडवाना पेड़-पौधों के पर्मियन तल्चीर एवं करहरबारी बांझ्ताओं के साथ द्विचिरकाली सहसंबंध सुझाते हैं। अर्जेंटीना और भारत के अंतिम पुराजीवी लाइकोप्सिड एवं संघटित स्थूलबीजाणुओं के साथ तुलनाएं बृहत परिप्रेक्ष्य में गोंडवाना जैवस्तरक्रमविज्ञान की ज्ञान प्राप्ति के उद्देश्य से आधुनिक अध्ययनों के साथ सहमत हैं।

संकेत-शब्द—कासिमोवियन-ग्ज़ेलियन, लाइकोपॉड्स, ब्राज़ीली गोंडवाना, मांटे मॉर (एसपी), पी जी बी संगुणने।

Licófitas do Pensylvaniano Superior Provenientes da Tafoflora Interglacial do Grupo Itararé, Bacia do Paraná, Brasil

RESUMO

Os estratos pensilvanianos do grupo Itararé estão presentes apenas na margem nordeste da bacia do Paraná partindo da região setentrional do estado do Paraná até a porção norte do estado de São Paulo. As licófitas pensilvanianas do grupo Itararé estão representadas por diversos megafósseis, megásporos e micrósporos. O presente estudo refere-se a macrofósseis licofíticos do terceiro nível interglacial da sucessão paleoflorística do Grupo Itararé na margem nordeste da bacia do Paraná, isto é, associação (PGB as.) *Paranocladus-Ginkgophyllum-Brasilodendron* coletados em sua localidade tipo Sítio Volpe, no município de Monte-Mor, SP. Os megafósseis pertencem aos taxa *Bumbudendron millani, B.* cf. *B. paganzianum, Brasilodendron pedroanum,* aff. *Brasilodendron* sp., *Leptophloeum* cf. *L. sanctae-helenae,* e cf. *Cyclodendron* sp. A diversidade e abundância dos macrofósseis (as vezes formando camadas de carvão em um contexto glacial) indicam melhorias climáticas de uma fase interglacial do tempo Itararé. Elas representam comunidades paleoecológicas hidro-higrófilas de um ambiente sedimentar fluvio-lacustre. A distribuição bio-estratigráfica destes taxa e suas associações com *Paranocladus, Ginkgophyllum e Buriadia* sugerem uma correlação paleoflorística com a fitozona *Krauselcladus – Asterotheca* do zoneamento paleoflorístico do noroeste argentino. Os megásporos licofíticos registrados anteriormente neste nível sugerem correlação diacrônica com as associações permianas de Talchir e Kaharbari da flora gondvânica indiana. Comparações com licófitas neopaleozóicas e megásporos associados da argentina e Índia estão em consonância com estudos modernos empenhados na conquista de conhecimentos da bioestratigrafia gondvânica em uma perspectiva mais ampla.

Palavras-chave—Khasimoviano-Gzheliano, Licófitas, Gondwana Brasileiro, Monte Mor (SP), Association PGB.

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Palynostratigraphic considerations on the Pennsylvanian interglacial microflora from Monte Mor (SP), Itararé Group, NE, Paraná Basin (Brazil) and its diachronic correlations with Indian Gondwana microflora

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ABSTRACT

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In the present communication the palynological contents of the Monte Mor taphoflora has been restudied in surface samples from the upper and lower levels of the coal beds from this type-locality and its Interval palynozone position has been reinterpreted and revised.

Four palynological Interval zones were recognized from the Upper Palaeozoic Brazilian Paraná Basin by Souza (2000, 2006) and Souza & Marques-Toigo (2001, 2003, 2005), where Monte Mor microflora was placed in the lowermost *Ahrensisporites cristatus* Interval Zone (tentatively Late Bashkirian to Kazimovian). On the basis of presence of *Crucisaccites monoletus, Divarisaccus* spp., *Faunipollenites* (=*Protohaploxypinus*) *amplus*, *Faunipollenites* sp., *Scheuringipollenites maximus*, *Platysaccus* sp. and *Scheuringipollenites maximus* in the recovered microflora it is suggested that Monte Mor palynoflora belongs to *Crucisaccites monoletus* Interval Zone, which is contrary to the earlier studies which indicated that the Monte Mor palynoassemblage belongs to *Ahrensisporites cristatus* Interval Zone.

Key-words—Palynology, Itararé Group, Monte Mor, Paraná Basin, Late Carbonifeorus, Brazil.

मांटे मोर (एस.पी.) इतारैर समूह, पराना द्रोणी (ब्राज़ील) से प्राप्त पेन्नसीलवेनियाई अंतः हिमनदीय सूक्ष्म वनस्पतिजात के परागाणुस्तरिक महत्व एवं भारतीय गोंडवाना सूक्ष्मवनस्पतिजात के साथ इसके द्विसमयसंबंधी सहसंबंध

नीरजा झा, सांद्रा ईको मुने, मैरी ई सी बर्नान्डीज-डी-ऑलीवीरा एवं नरेश सी. मेहरोत्रा

सारांश

मौजूदा संप्रेषण में ऐसी उपबस्तियों से कोयला संस्तरों के ऊपरी व निचले स्तरों से प्राप्त पृष्ठीय नमूनों में मांटे मोर जैववनस्पति-जात की परागाणविक अंतर्वस्तुओं का पुनर्अध्ययन किया गया है तथा इसकी परागाणुमंडल स्थिति पुनर्व्याख्यायित व परिशोधित की ई है।

सूज़ा (2000, 2006) एवं सूज़ा व मार्क्स-टॉइगो (2001, 2003, 2005) ने ऊपरी पुराजीवी ब्राज़ीली पराना द्रोणी से चार परागाणविक अंतराल मंडल पहचाने, जिसमें मांटे मोर सूक्ष्मवनस्पतिजात निचलीतम *एरेन्सीस्पोराइटिस क्रिस्टेटस* अंतराल मंडल (प्रयोग के तौर पर अंतिम बशकीरियाई से काज़ीमोनियाई तक) में नियत की गई थी। प्राप्त सूक्ष्म पेड़-पौधों में *क्रुसिसेक्काइटिस मोनोलिटस, डिवेरीसेक्कस* जातियां, *फॉनिपॉल्लेनाइटिस (=प्रोटोहैप्लॉक्सीपाइनस) एम्प्लस, फॉनिपॉल्लेनाइटिस* जाति, *श्युरिंगीपॉल्लेनाइटिस मैक्ज़ीमस, प्लेटीसेक्कस* जाति की विद्यमानता के आधार पर सुझावित किया जाता है कि मांटे मोर परागाणु पेड़पौधे *क्रुसिसेक्काइटिस मोनोलेटस* अंतराल मंडल के हैं जो पहले के अध्ययनों के विपरीत है जिसने संकेत दिया कि मांटे मोर परागाणु समुच्चय *एरेन्सीस्पोराइटिस क्रिस्टेटस* अंतराल मंडल की है।

संकेत-शब्द—परागाणुविज्ञान, इतारैर समूह, मांटे मोर, पराना द्रोणी, अंतिम कार्बोनिफेरस, ब्राज़ील

Considerações palinoestratigráficas sobre a microflora interglacial Pensilvaniana de Monte Mor (SP), Grupo Itararé, nordeste da Bacia do Paraná (Brasil) e suas correlações diacrônicas com a microflora Gondvânica Indiana

RESUMO

Neste trabalho, o conteúdo palinológico da tafoflora de Monte Mor foi re-estudado com base em amostras de superfície procedentes de níveis superiores e inferiores das camadas de carvão, desta localidade-tipo, e sua posição no palinozoneamento de intervalo foi reinterpretada e revista. Quatro zonas de intervalo palinológicos foram reconhecidas no Paleozóico superior da bacia do Paraná no Brasil, por Souza (2000, 2006) e Souza & Marques-Toigo (2001, 2003 e 2005), onde a microflora de Monte Mor foi colocada na zona de intervalo mais inferior chamada de *Ahrensisporites cristatus* (tentativamente Neo Bashkiriano a Kazimoviano). Com base na presença de *Crucisaccites monoletus, Divarisaccus* spp, *Faunipollenites* (=*Protohaploxypinus*) *amplus*, *Faunipollenites sp., Scheuringipollenites maximus*, *Platysaccus sp.* e *Scheuringipollenites maximus* na microflora coletada, sugere-se que a palinoflora de Monte Mor pertencem a zona de intervalo *Crucisaccites monoletus* contrariando estudos anteriores que indicam que a palinoassembléia de Monte Mor pertence a Zona de Intervalo *Ahrensisporites cristatus*.

Palavras-chave—Palinologia, Grupo Itararé, Monte Mor, Bacia do Paraná, Neocarbonifero, Brasil.

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On the Permian permineralized woods of the "Fossil Flora of the Coal Measures of Brazil" (D. White, 1908): taxonomic re-evaluation

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ABSTRACT

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D. White published, in 1908, the "Report on the Fossil Flora of the Coal Measures of Brazil", an important work that became a reference for the study of fossil plants collected mainly from Early Permian sediments of the Paraná Basin. In this work, the author described for the first time a large number of plant fossils collected in the states of Santa Catarina and Rio Grande do Sul, including a few pieces of permineralized wood. This paper presents the first taxonomic re-evaluation of the permineralized woods described by D. White, using the samples on which he based his descriptions. *Sigillaria (?) muralis* White is transferred to the genus *Scalaroxylon*, due to presence of scalariform pitting on the radial walls of the tracheids, thus forming a new combination *Scalaroxylon muralis* (White); *Araucarioxylon nummularium* (White) Maheshwari is transferred to the genus *Brachyoxylon*, because of the araucarioid character of its radial- wall pits and cross- fields, thus forming a new combination *Brachyoxylon nummularium* (White); *Araucarioxylon meridionale* (White) Maheshwari is considered as an dubios taxon due to non- preservation of its cross- field pits. The re-evaluation of the fossils described by White enabled a better understanding of the botanical affinities of the *Glossopteris* flora from southern Brazil. For the first time, the genus *Scaraloxylon* is recorded in the Permian; until now it had only been found in the Triassic and Cretaceous of Gondwana.

Key-words—D. White's Report, Permineralized woods, Taxonomy, Paraná Basin, Permian.

"ब्राज़ील में कोयला युक्त संस्तर के जीवाश्म पेड़-पौधे" (डी.व्हाइट, 1908) के पर्मियन पर्मियनीकृत काष्ठः वर्गिकीय पुनर्मूल्यांकन

फ्रान्सीने कुर्ज़वे, राबर्टो इआन्नुज़्ज़ी एवं शीला मर्लोट्टी

सारांश

डी. व्हाइट ने 1908 में "ब्राज़ील में कोयला युक्त संस्तर के जीवाश्म पेड़-पौधों पर रिपोर्ट" प्रकाशित की, एक महत्वपूर्ण कार्य जो, मुख्यतः पराना द्रोणी के प्रारंभिक पर्मियन अवसादों से संगृहीत जीवाश्म पादपों के अध्ययन हेतु एक संदर्भ बन गया। उस शोध कार्य में पर्मियनकृत काष्ठ के कुछेक खंडों को सन्निहित करते हुए लेखक ने पहली मरतबा सैंट कैटरिना एवं रियो ग्रांन्द दो सुल के राज्यों में संगृहीत पादप जीवाश्मों की बहुत बड़ी संख्या वर्णित की। यह शोध-पत्र डी. व्हाइट द्वारा वर्णित पर्मियनीकृत काष्ठों का पहली बार वर्गिकीय पुनर्मूल्यांकन प्रस्तुत करता है। वाहिनिकाओंकी अरीय दीवारों पर सीढ़ीनुमा गर्तन की विद्यमानता की वजह से *सिजिल्लेरिया(?) मुरैलिस* व्हाइट, *स्कैलरॉक्सिलॉन* वंश को स्थानांतरित हो गया है, इस प्रकार एक नवीन संयोजन *स्कैलरॉक्सिलॉन मुरैलिस* व्हाइट गठित

कर रहा है; अपने अरीय-दीवार गर्त एवं क्रॉसित क्षेत्रों के एरौकेरिऑइड अभिलक्षणन के कारण *एरौकेरिऑक्सीलॉन नुम्मुलेरियम* (व्हाइट) माहेश्वरी *ब्रैकीऑक्सीलान* वंश को स्थानांतरित हो गया है; अपने क्रॉसित-क्षेत्र गर्तों के गैर-परिरक्षण की वजह से एक अस्पष्ट टैक्सान के रुप में *एरौकेरिऑक्सीलॉन मेरिडायोनेल* (व्हाइट) माहेश्वरी पर गौर किया गया है। व्हाइट के वर्णित जीवाश्मों के पुनर्मूल्यांकन से दक्षिणी ब्राज़ील से प्राप्त *ग्लोसोप्टेरिस* वनस्पति-जात की वानस्पतिक बंधुताओं को बेहतर समझने में मदद मिली। पर्मियन में पहली बार *स्कैलरॉक्सिलॉन* अभिलिखित किया गया है; अब तक यह गोंडवाना के ट्राइऐसिक व क्रिटेशियस में पाई गई थी।

संकेत-शब्द—डी. व्हाइट की रिपोर्ट, पर्मियनीकृत काष्ठें, वर्गिकी, पराना द्रोणी, पर्मियन

Sobre os lenhos permineralizados Permianos da "Flora Fóssil das Coal Measures Brasil" (D. White, 1908): reavaliação taxonômica

RESUMO

D. White publicou em 1908 "Relatório sobre a flora fóssil das coal measures do Brasil", um importante trabalho que se tornou uma referência para o estudo de plantas fósseis coletados principalmente de sedimentos eopermianos da bacia do Paraná. Naquele trabalho o autor descreveu pela primeira vez um grande número de plantas fósseis coletados nos estados de Santa Catarina e Rio Grande do Sul, incluindo poucas peças de lenhos permineralizados. Este trabalho apresenta a primeira reavaliação taxonômica dos lenhos permineralizados descritas por D.White usando as amostras sobre as quais ele baseou suas descrições. *Sigillaria (?) muralis* White foi transferida para o genero *Scalaroxylon,* devido a presença de pontoações escalariformis sobre as paredes radiais das traqueídes constituindo uma nova combinação *Scalaroxylon muralis* (White); *Araucarioxylon nummularium* (White) Maheshwari é transferida para o gênero *Brachyoxylon*, devido ao caráter araucarióide de suas perfurações de parede radial e campos cruzados, daí formando uma nova combinação *Brachyoxylon nummularium* (White); *Araucarioxylon meridionale* (White) Maheshwari foi considerado como um táxon duvidoso devido a não preservação de suas pontuações de campo cruzado. A reavaliação dos fósseis descritos por White possibilitaram um melhor entendimento das afinidades botânicas da flora de glossopteris do sul do Brasil. Pela primeira vez o gênero *Scaraloxylon* é documentado no permiano; até o momento tinha sido somente encontrado no Triássico e Cretáceo do gondwana.

Palavras-chave—Relatório de D. White; Lenhos Permineralizados, Taxonomia, Bacia do Paraná, Permiano.

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New evidence of plant-insect interactions in the Lower Permian from Western Gondwana

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ABSTRACT

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A new record of insect damages-containing glossopterid leaves is recovered from the Rio da Estiva outcrop, Itaiópolis country, northernmost Santa Catarina State, southern Brazil. The plant fossil-bearing strata are situated, stratigraphically, from the basal to middle part of the Rio Bonito Formation, a unit of the Lower Permian sequence of the Paraná Basin. This plant assemblage is characterized as "pure *Glossopteris* Flora", and contains remains of glossopterid leaves (*Glossopteris* spp. and *Gangamopteris* sp.), seeds (*Samaropsis* sp. and *Cordaicarpus* sp.) and fructification (*Ottokaria* sp.). We analyzed 102 samples, of which only ten showed evidence of insect damages. Three types of leaf feeding traces are observed: leaf margin feeding traces, hole feeding traces and trench feeding traces. The damages occurred in leaves of *Glossopteris* sp., *Glossopteris communis, Glossopteris occidentalis* and *Gangamopteris obovata*. The evidence of consumption of foliar tissues indicated that glossopterids hosted a functional feeding group of predominantly chewing and sucking type of insects. The differences found in the patterns and frequencies of consumption in different localities of equivalent ages suggested that herbivory was more intensive in some plant communities than in others. Besides this, the present study expanded geographically the distribution of records of plant-insect interactions in "*Glossopteris* flora" through the central portion of the eastern rim of Paraná Basin.

Key-words—*Glossopteris* flora, Herbivory, Rio Bonito Formation, Paraná Basin, Early Permian.

पश्चिमी गोंडवाना से प्राप्त निम्न पर्मियन में पादप-कीट अन्योन्य-क्रियाओं का नवीन प्रमाण

ई आर एस पाइन्हीरो, जी.पी. तायबुश एवं राबर्टो इआन्नुज़्ज़ी

सारांश

रियो डा एस्टिवा शैल दृश्यांश, ईटइओपॉलिस देश, सुदूरउत्तरी सेंटा कैटरीना राज्य, दक्षिणी ब्राज़ील से कीट क्षति-ग्लोसोप्टेरिड पत्तियां सन्निहित नवीन अभिलेख प्राप्त हुआ है। पादप जीवाश्म-धारी पट्टीदार पराना द्रोणी निम्न पर्मियन अनुक्रम की यूनिट रियोबॉनिटो शैलसमूह के आधार से मध्य भाग तक स्तरिक रूप में स्थित हैं। पादप समुच्चय ''शुद्ध *ग्लोसोप्टेरिस* वनस्पति-जात'' के रूप में विशिष्ट गुणयुक्त है तथा ग्लोसोप्टेरिड पत्तियों (*ग्लोसोप्टेरिस* जातियां व *गंगामॉप्टेरिस* जाति), बीज (*सैमरॉप्सिस* जाति व *कॉर्डाइकार्पस* जाति) एवं फलनों (*ओट्टोकेरिया* जाति) के अवशेष सन्निहित है। हमने 102 नमूने विश्लेषित किए जिनमें से दस ने कीट क्षति के प्रमाण दर्शाए। तीन तरह के पत्ती आहार अनुपथ प्रेक्षित किए गए हैं: पत्ती उपांत आहार अनुपथ, छिद्र आहार अनुपथ एवं खांचा आहार अनुपथ। *ग्लोसोप्टेरिस* जाति, *ग्लोसोप्टेरिस कम्युनिस, ग्लोसोप्टेरिस ऑसिडेंटेलिस* एवं *गंगामॉप्टेरिस ओबोवेटा* की पत्तियों में क्षति हुई। पर्णिल उत्तकों के उपभोग के प्रमाण ने इंगित किया कि ग्लोसोप्टेरिडों ने प्रबल पूर्व चबाने के एक क्रियात्मक आहार समूह तथा चूषक प्रकार के कीटों की परपोषी की। सम आयु की विविध उपबस्तियों में खपत के प्ररूपों एवं आवृतियों में पाए गए भेदों ने सुझाया कि कुछ पादप समुच्चयों की अपेक्षा अन्य में शाकाहारी वर्ग ज़्यादा गहन था। इसके अलावा, मौजूदा अध्ययन ने पराना द्रोणी में पूर्वी परिधि के मध्य भाग से *'ग्लोसोप्टेरिस* पेड़-पौधे'' में पादप-कीट परस्पर क्रियाओं के अभिलेखों को भौगोलिक रूप से विस्तृत किया।

संकेत-शब्द—*ग्लोसोप्टेरिस* पेड़-पौधे, शाकाहारी वर्ग, रियो बॉनिटो शैलसमूह, पराना द्रोणी, पर्मियन पूर्व।

Novas evidências de interações inseto-plantas no Permiano Inferior do Gondwana

RESUMO

Um novo registro de folhas de glossopterídeas contendo danos por insetos foi obtido no afloramento de Rio da Estiva, município de Itaiópolis, região norte do Estado de Santa Catarina, no Brasil meridional. Os estratos portadores dos fitofósseis estão situados, estratigraficamente, na porção basal a mediana da Formação Rio Bonito, uma unidade do Permiano Inferior da Bacia do Paraná. Esta assembléia fitofossilífera é considerada como uma "Flora de *Glossopteris* pura", contendo restos de folhas de glossopterídeas (*Glossopteris* spp. e *Gangamopteris* sp.), sementes (*Samaropsis* sp. e *Cordaicarpus* sp.) e frutificações (*Ottokaria* sp.). Foram analisadas 102 amostras, das quais somente dez mostram evidências de danos por insetos. Três padrões de consumo foliar foram observados: traços de alimentação marginal, traços de alimentação circular e de alimentação linear sobre lâmina. Os danos foram observados em folhas de *Glossopteris* sp., *Glossopteris communis, Glossopteris occidentalis* e *Gangamopteris obovata*. A evidência de consumo de tecidos foliares indica que as glossopterídeas eram herbivorizadas por insetos predominantemente com aparelho bucal mastigador. As diferenças encontradas nos padrões de freqüência de herbivoria entre as diferentes localidades de idades equivalentes sugeriram que a atividade foi mais intensa em algumas comunidades do que em outras. Além disso, o presente estudo expandiu geograficamente a distribuição de registros de interação inseto-planta na flora de glossopteris através da porção central da margem oriental da Bacia do Paraná.

Palavras-chave—Flora de *Glossopteris*; Herbivoria, Formação Rio Bonito, Bacia do Paraná, Eopermiano.

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Palaeobotanical evidence of wildfire in the Upper Permian of India: Macroscopic charcoal remains from the Raniganj Formation, Damodar Basin

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ABSTRACT

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Macroscopic fossil charcoal has been discovered in the carbonaceous shales associated with Seam-VI of Raniganj Formation, Upper Permian, Damodar Basin, India. A pycnoxylic gymnosperm wood is described and confirms the occurrence of palaeo-wildfire in this area during the Late Permian. The integration of the data presented in the current study with previously published data for the Raniganj Formation, principally related to the occurrence of (pyrogenic) inertinites within coal layers, demonstrates that palaeo-wildfires were common events during the deposition of the preserved material. In addition, the presence of charcoal in Permian sediments associated with coal levels at different Gondwana localities demonstrates that wildfires have been relatively common events across the continent during this period.

Key-words—Charcoal, Gymnosperm woods, Palaeo-wildfires, Upper Permian, Raniganj Formation, Raniganj Coalfield, Damodar Basin.

भारत के ऊपरी पर्मियन में वन अग्नि के पुरावानस्पतिक साक्ष्यः रानीगंज शैलसमूह दामोदर द्रोणी से प्राप्त स्थूल लकड़ी के कोयले के अवशेष

एंड्रे जैसपर, मार्गोट गुएरा-सॉमर, डाइटर उह्ल, मैरी ई सी बर्नान्डीज-डी-ऑलीवीरा, अमित के घोष, रजनी तिवारी एवं मेरिएला आइन्स सेक्ची

सारांश

रानीगंज शैलसमूह ऊपरी पर्मियन, दामोदर द्रोणी, भारत की संस्तर-षष्ठम कार्बनमय जीवाश्म शेल सहयोगी में स्थूल जीवाश्म चारकोल अन्वेषित किया गया है। घनदारुक अनावृतबीजी काष्ठ वर्णित की गई है तथा अंतिम पर्मियन के दौरान इस क्षेत्र में पुरा-दावाग्नि की घटना की पुष्टि करती है। रानीगंज शैलसमूह हेतु पूर्व में प्रकाशित आंकड़े के साथ मौजूदा अध्ययन में प्रस्तुत आंकड़े का एकीकरण, कोयला परतों के साथ (अग्निजनिक) इनर्टीनाइटों की सैद्धांतिक रुप से प्राप्ति

प्रदर्शित करती है कि परिरक्षित पदार्थ के निक्षेपण के दौरान पुरा-दावाग्नि आम घटनाएं थीं। इसके अलावा, विभिन्न गोंडवाना क्षेत्रों में कोयला स्तरों के सहयोगी पर्मियन अवसादों में चारकोल की मौजूदगी प्रदर्शित करती है कि इस अवधि में समूचे महाद्वीप में दावाग्नि सापेक्षतया आम घटनाएं रही हैं।

संकेत-शब्द—लकड़ी का कोयला, अनावृतबीजी काष्ठ, पुरा-दावाग्नि, ऊपरी पर्मियन, रानीगंज शैलसमूह, रानीगंज कोयलाक्षेत्र, द्मोदर द्रोणी।

Evidências Paleobotânicas de Paleoincêndios no Permiano Superior da Índia: Registro de Charcoal Macroscópico da Formação Raniganj, Bacia Damodar Valley

RESUMO

Charcoal macroscópico fóssil foi descoberto em níveis ricos em matéria orgânica associados à Sequência VI da Formação Raniganj, Permiano Superior, Bacia Damodar Valley, Índia. Um lenho picnoxilico gimnospérmico é descrito e confirma a ocorrência de paleoincêndios vegetacionais na área durante o Neopermiano. A integração dos dados aqui apresentados com aqueles já publicados acerca da Formação Raniganj, principalmente aqueles relacionados à ocorrência de inertinitas (de origem pirogênica) em níveis de carvão, demostraram que paleoincêndios foram eventos comuns durante a deposição dos níveis estudados. Além disso, a presença de charcoal em sedimentos Permianos associados a níveis de carvão em diferentes localidades do Gondwana confirma que este tipo de evento foi relativamente comum no continente durante esse período.

Palavras-chave—Charcoal, Lenhos Gimnospérmicos, Paleoincêndios vegetacionais, Permiano Superior, Formação Raniganj, Mina Raniganj, Bacia Damodar Valley

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Stratigraphic ranges of dinoflagellate cysts from Cretaceous petroliferous basins of India and Brazil

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ABSTRACT

Mehrotra NC, Tewari R, Arai M, Garcia MJ & Bernardes-de-Oliveira MEC 2012. Stratigraphic ranges of dinoflagellate cysts from Cretaceous petroliferous basins of India and Brazil. The Palaeobotanist 61(1): 83-102.

Development of dinoflagellate cyst studies in India and Brazil is directly related with the exploration of hydrocarbons. During the last 3 decades these studies have intensified in various petroliferous basins of the two countries. These have proved to be of immense value in high impact palynological studies as applied in geological modelling for exploration. Stratigraphic ranges of significant dinoflagellate taxa from the two countries have been analysed in global context and presented through 6 Range Tables. This is the first step to build comparative database of these fossils from India and Brazil for obtaining a better understanding of their distribution and application in petroleum industry.

Key-words—Stratigraphic ranges, Dinoflagellate cysts, India, Brazil, Exploration of hydrocarbons.

भारत व ब्राज़ील की क्रिटेशियस पेट्रोलियमधारी द्रोणियों से प्राप्त घूर्णीकशाभ पुटियों के स्तरिक रेंज

नरेश सी मेहरोत्रा, रजनी तिवारी, मित्सुरु एरै, मारिया जुडीटे एवं मैरी ई सी बर्नान्डीज-डी-ऑलीवीरा

सारांश

भारत एवं ब्राज़ील में घूर्णीकशाभ पुटी अध्ययनों का विकास हाइड्रोकार्बनों के अन्वेषण से सीधे संबंधित है। पिछले तीन दशकों के दौरान ये अध्ययन इन दो देशों की विभिन्न पेट्रोलियमधारी द्रोणियों में बढ़े हैं। अन्वेषण हेतु भू-वैज्ञानिकीय प्रतिरुपण मे यथा अनुप्रयुक्त उच्च प्रभावी परागाणविक अध्ययनों में इनके असीम महत्व को सिद्ध कर दिया है। इन दो देशों से प्राप्त महत्वपूर्ण घूर्णीकशाभ टैक्सा के स्तरिक परिसर भू-मंडलीय परिप्रेक्ष्य में विश्लेषित किए गए हैं और 6 रेंज तालिकाओं के माध्यम से प्रदर्शित किए गए। पेट्रोलियम उद्योग में इनके वितरण एवं अनुप्रयोग को बेहतर समझने हेतु भारत व ब्राज़ील से प्राप्त इन जीवाश्मों के तुलनात्मक आंकड़ा आधार बनाने में यह पहला कदम है।

संकेत-शब्द—स्तरिक परिसर, घूर्णीकशाभ पुटियां, भारत, ब्राज़ील, हाइड्रोकार्बन का अन्वेषण।

Amplitudes estratigráficas de cistos de dinoflagelados das bacias petrolíferas Cretáceas da Índia e do Brasil

RESUMO

Desenvolvimento de estudos de cistos de dinoflagelados na Índia e no Brasil está diretamente relacionado com a exploração de hidrocarbonetos. Durante as três últimas décadas estes estudos tem se intensificado nas várias bacias petrolíferas de ambos os países. Isto provou ser de imenso valor em estudos palinológicos de alto impacto conforme aplicado nos modelos geológicos de exploração. Distribuições estratigráficas de importantes taxons de dinoflagelados dos

dois países foram analisadas num contexto global e apresentado em 6 tabelas estratigráficas. Este é um primeiro passo na construção de bases de dados comparativos destes fósseis da Índia e do Brasil para obter uma melhor compreensão de suas distribuição e aplicação na industria de petróleo.

Palavras-chave—Distribuições estratigráficas, Cistos de dinoflagelados, Índia, Brasil, Exploração de hidrocarbonetos.

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Stromatolites of the Kaladgi Basin, Karnataka, India: Systematics, biostratigraphy and age implications

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ABSTRACT

Sharma M & Pandey SK 2012. Stromatolites of the Kaladgi Basin, Karnataka, India: Systematics, biostratigraphy and age implications. The Palaeobotanist 61(1): 103-121.

Systematics of the stromatolites of the Proterozoic Kaladgi Basin is attempted. The main purpose is to document the diversity and distribution of the various stromatolite forms occurring in the Bagalkot Group of the Kaladgi Supergroup. An assemblage of six taxa is recognized from the Bagalkot Group. The forms *Asperia digitata (=Yelma digitata)*, *Ephyaltes edingunnensis, Eucapsiphora leakensis, Kussoidella karalundiensis*, *Pilbaria deverella* and *Yandilla meekatharrensis* are described. These forms are not recorded from any other Proterozoic Sequence of India of the Palaeoproterozoic age. Similar forms are recorded from Africa, Australia, Canada and China. *Asperia digitata*, a digitate stromatolite, is known from the Proterozoic Sequence of the Palaeoproterozoic age in other parts of the world. Poorly constrained age of the Bagalkot Group of the Kaladgi Supergroup can be ascertained on the basis of the reported assemblage as Late Palaeoproterozoic to Early Mesoproterozoic (Orosirian-Statherian to Calymmian Period).

Key-words—Stromatolites, Systematics, Kaladgi Supergroup, Palaeoproterozoic, Karnataka, India.

कलाड्गी द्रोणी, कर्नाटक, भारत के स्ट्रोमैटोलाइट्सः वर्गिकी, जैवस्तरिकी एवं आयु निहितार्थ

मुकुंद शर्मा एवं एस.के. पांडे

सारांश

प्राग्जीव कलाड्गी द्रोणी में स्ट्रोमैटोलाइट्स की वर्गिकी का प्रयास किया गया है। कलाड्गी उच्चसमूह के बागलकोट समूह में प्राप्त हो रहे विविध स्ट्रोमैटोलाइट् रुपों की विविधता व वितरण का प्रलेख करना मुख्य उद्देश्य है। बागलकोट समूह से छः टैक्सा की एक समुच्चय अभिनिर्धारित की गई है। इन रुपोंः *एस्पेरिया डिजीटाटा (=येल्मा डिजिटाटा), एफीयलेटीज एडिंगनेन्सिस, इयुकैप्सीफोरा लीकेन्सिस, कुसेडेल्ला कर्लुडेन्सिस, पिल्बेरिया डेवरेल्ला* एवं *यंडिला मीकेथरेन्सिस* के वर्णन दिए गए हैं। पुराप्राग्जीव काल में भारत के किसी अन्य प्राग्जीव अनुक्रम से ये रुप अभिलिखित नहीं किए गए हैं।अफ्रीका, आस्ट्रेलिया, कनाडा एवं चीन से इसके सदृश रुप अभिलिखित किए गए हैं। दुनिया के अन्य भागों में पुराप्राग्जीव काल के प्राग्जीव अनुक्रम से अंगुष्ठाकार स्ट्रोमैटोलाइट् *एस्पेरिया डिजिटाटा* ज्ञात है। वर्णित समुच्चय के आधार पर कलाड्गी उच्चसमूह में बागलकोट समूह की आयु अंतिम पुराप्राग्जीव से प्रारंभिक मध्य प्राग्जीव (ओरोसिरियन-स्टेथेरियन से कैलीम्मियन अवधि) जो पहले नियत नहीं थी निर्धारित की जा रही है।

संकेत-शब्द—स्ट्रोमैटोलाइट्, वर्गिकी, कलाड्गी उच्चसमूह, पुराप्राग्जीव, कर्नाटक, भारत।

Stromatólitos da Bacia Kaladgi, Karnataka, India: Implicações sistemáticas, bioestratigráficas e de idade

RESUMO

A sistemática dos estromatólitos da bacia proterozóica Kaladgi é preliminarmente estabelecida. O principal objetivo é documentar a diversidade e a distribuição das formas de vários estromatólitos ocorrentes no Grupo Bagalkot do Supergrupo Kaladgi. Uma assembléia de seis táxons é reconhecida como sendo do grupo Bagalkot. As descrições são feitas para estas

formas: *Asperia digitata (=Yelma digitata), Ephyaltes edingunnensis, Eucapsiphora leakensis, Kussoidella karalundiensis*, *Pilbaria deverella* e *Yandilla meekatharensis* que não são registradas em nenhuma outra sequência paleoproterozóica da Índia. Formas similares são registradas na África, Austrália, Canadá e China. *Asperia digitata*, um estromatólito digitado é conhecido a partir da sequência paleoproterozóica de outras partes do mundo. Idade precariamente estabelecida do Grupo Bagalkot do Supergrupo Kaladgi pode ser determinada com base na assembléia registrada como neo-paleoproterozóica a eo-mesoproterozóica (Períodos Orosiriano-Stateriano a Calimiano).

Palavras-chave—Estromatólitos, Sistemáticas, Supergrupo Kaladgi, Palaeoproterózoico, Karnataka, India.

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Gymnospermous seeds from the Barakar Formation of Umrer Coalfield, Wardha Basin, Maharashtra

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ABSTRACT

Tewari R, Mehrotra NC, Pillai SSK, Pandita SK & Agnihotri D 2012. Gymnospermous seeds from the Barakar Formation of Umrer Coalfield, Wardha Basin, Maharashtra. The Palaeobotanist 61(1): 123-130.

Platyspermic and radiospermic gymnospermous seeds are documented from the top seam of the Barakar Formation, Makardhokra Open Cast Project, Umrer Coalfield, Nagpur District, Wardha Basin, Maharashtra. A variety of seed types including *Cordaicarpus* sp., *Cordaicarpus zeilleri*, *Samaropsis feistmantelii, Samaropsis* sp., *Rotundocarpus ovatus* and a new species, viz. *Rotundocarpus mucronatus* are systematically described. The seeds are largely comparable with those described from the Karharbari Formation of Damodar Basin. Besides adding to the knowledge of the flora of the Wardha Basin, this communication provides information on the occurrence of these seeds for the first time from Makardhokra Open Cast Project, Umrer Coalfield.

Key-words—Gymnospermous seeds, Platyspermic, Radiospermic, Early Permian, Barakar Formation, Umrer Coalfield, Wardha Basin.

उमरेर कोयलाक्षेत्र, वर्धा द्रोणी, महाराष्ट्र के प्रारंभिक पर्मियन अनुक्रम से प्राप्त अनावृतबीजी बीज

रजनी तिवारी, नरेश सी. मेहरोत्रा, एस एस के पिल्लै, संदीप पंडिता एवं दीपा अग्निहोत्री

सारांश

बराकार शैलसमूह, मकरढ़ोकरा विवृत खान परियोजना, उमरेर कोयलाक्षेत्र, जिला नागपुर, वर्धा द्रोणी, महाराष्ट्र की उच्च संस्तर से प्राप्त चिपिटबीजी एवं त्रिज्यबीजी अनावृतबीजी बीज प्रलेखित किए गए हैं। *कॉर्डीइकार्पस ज़ाइलराई, कॉर्डेकार्पस*जाति, *सेमेरॉप्सिस फ़ाइस्टमेंटलाई, सम्रॉप्सिस* जाति, *रोटंडोकार्पस ओवेटस* एवं एक नवीन जाति अर्थात *रोटंडोकार्पस मुक्रोनेटस* सहित बीज टैक्सा के प्रकार क्रमबद्ध रुप से विश्लेषित किए गए हैं। ये बीज दामोदर द्रोणी में करहरबारी शैलसमूह के पहले वर्णित किए गए बीजों के सम तुल्य हैं। उमरेर कोयलाक्षेत्र के बराकार शैलसमूह में इनकीविद्यमानता करहरबारी शैलसमूह के पुष्पी तत्वों की निरंतरता रुपायित करती है। वर्धा द्रोणी में वनस्पति-जात की जानकारी शामिल करने के अलावा, यह संप्रेषणमकरढ़ोकरा विवृत खान परियोजना, उमरेर कोयलाक्षेत्र से पहली बार इन बीजों की प्राप्ति की जानकारी प्रदान करता है।

संकेत-शब्द—अनावृतबीजी बीज, चिपिटबीजी, त्रिज्यबीजी, प्रारंभिक पर्मियन, बराकार शैलसमूह, उमरेर कोयलाक्षेत्र, वर्धा द्रोणी।

Sementes Gymnospérmicas da sequência eopermiana do Hulhífero Umrer, Bacia de Wardha, Maharashtra

RESUMO

Sementes radiospérmicas e platispérmicas estão documentadas no topo da Formação Barakar, Makardhokra Open Cast Project, Hulhífero Umrer, Distrito de Nagpur, Bacia de Wardha, Maharashtra. Uma variedade de sementes incluindo

Cordaicarpus zeilleri, Cordaicarpus sp., *Samaropsis feistmantelii, Samaropsis* sp., *Rotundocarpus ovatus* e uma nova espécie,*viz. Rotundocarpus mucronatus* são sistematicamente analisadas. As sementes são comparáveis com aquelas descritas da Formação Karharbari da bacia Damodar. Sua presença na formação no hulhífero Umrer representa a continuidade de elementos florais da Formação Karharbari. Além de acrescentar conhecimento da flora da bacia de Wardha, esta comunicação fornece informações da ocorrência destas sementes pela primeira vez no projeto Makardhokra Open Cast, Hulhífero Umrer.

Palavras-chave—Sementes gimnospérmicas, Platispérmica, Radiospérmica, Neopermiano, Formação Barakar, Hulhífero Umrer, Bacia de Wardha.

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A basal Gondwana palynoflora from the glacigene sediments of Tatapani-Ramkola Coalfield, India

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ABSTRACT

Kar R 2012. A basal Gondwana palynoflora from the glacigene sediments of Tatapani-Ramkola Coalfield, India. The Palaeobotanist 61(1): 131-138.

Palynological studies were undertaken on the sediments of Talchir Formation exposed along a stream cutting in the Tatapani-Ramkola Coalfield, Chhattisgarh State, India. The glacigenic nature of the Talchir Formation is evident, as manifested by the presence of lithified tillites, varves and rafted boulders. The varve clays have yielded a well preserved assemblage rich in radial monosaccates. The assemblage is dominated by *Plicatipollenites* (26-31%) with a sub-dominance of *Parasaccites* (8-22%). *Potonieisporites*, *Virkkipollenites*, *Caheniasaccites* and *Sahnites* are the other important constituents. The recovered palynoflora is characteristic of *Plicatipollenites-Parasaccites* palynoassemblage, which represents Lower Talchir palynozone and is of early Permian age.

Key-words—Gondwana, Palynology, Talchir Formation, Early Permian, Tatapani-Ramkola Coalfield.

तातापानी-रामकोला कोयलाक्षेत्र, भारत के ग्लेसीजीन अवसादों से प्राप्त एक आधारी गोंडवाना परागाणुवनस्पति-जात

रतन कर

सारांश

तातापानी-रामकोला कोयलाक्षेत्र, छत्तीसगढ़ राज्य, भारत में सरिता कर्तन के सहारे अनावरित तल्चीर शैलसमूह के अवसादों के परागाणविक अध्ययनों का जिम्मा लिया गया। शिलीभूत टिलाइटों, अनुवर्षस्तरी व चाटी गोलाशम की विद्यमानता से यथा सुस्पष्ट तल्चीरशैलसमूह की ग्लेसीजेनिक प्रकृति साक्ष्य है। अनुवर्षस्तरी मृत्तिका से त्रिज्य एकलसपुटों में प्रचुर सुपरिरक्षित समुच्चय मिली है। समुच्चय*पैरासैक्काइटिस*(8-22 प्रतिशत) की उप-प्रभुत्वता सहित *प्लिकेटीपॉल्लेनाइटिस*(26-31 प्रतिशत) से प्रभावी है। *पोटोनियाईस्पोराइटिस, विर्कीपॉल्लेनाइटिस, कहेनियासेक्काइटिस*एवं *साहनाइटिस* अन्य महत्वपूर्ण अंतर्वस्तुएं हैं। प्राप्त परागाणु वनस्पति-जात *प्लिकेटीपॉल्लेनाइटिस-पैरासेक्काइटिस*परागाणु समुच्चय की विशेषता है जो निम्न तल्चीर परागाणुमंडल एवं प्रारंभिक पर्मियन काल का द्योतक है।

संकेत-शब्द—गोंडवाना, परागाणुविज्ञान, तल्चीर शैलसमूह, प्रारंभिक पर्मियन, तातापानी-रामकोला कोयलाक्षेत्र।

Uma Palinoflora Gondvânica basal dos sedimentos glacigenos do Hulhífero Tatapani-Ramkola, Índia

RESUMO

Estudos palinológicos foram realizados nos sedimentos da Formação Talchir, exposta ao longo da margem de um córrego no Hulhífero Tatapani-Ramkola, Estado de Chhattisgarh, India. A natureza glacígena da Formação Talchir é evidenciada pela presença de tilitos litificados, varvitos e matacões estriados. As argilas várvicas produziram uma assembléia bem preservada, rica em grãos de pólen monosacados radiais. A assembléia é dominada por *Plicatipollenites* (26-31%), com um sobdomínio de *Parasaccites* (8-22%). Outros constituintes importantes são os *Potonieisporites*, *Virkkipollenites*, *Caheniasaccites* e os *Sahnites*. A palinoflora obtida é característica da palinoassembléia *Plicatipollenites-Parasaccites*, que representa a palinozona Talchir Inferior e é de idade eopermiana.

Palavras-chave—Gondwana, Palinologia, Formação Talchir, Eopermiano, Hulhífero Tatapani-Ramkola.

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Cheirophyllum maithyi sp. nov. from the Early Permian of Pench Valley Coalfield, Satpura Gondwana Basin, India

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ABSTRACT

Pillai SSK 62012. *Cheirophyllum maithyi* sp. nov. from the Early Permian of Pench Valley Coalfield, Satpura Gondwana Basin, India. The Palaeobotanist 61(1): 139-143.

A new species of the genus *Cheirophyllum*, viz. *C. maithyi* is described from the Pench East Incline underground project, Pench Valley Coalfield, Satpura Gondwana Basin, Madhya Pradesh. The species is characterized by absence of apical lobes, obtuse apex and ridges and furrows on lamina. Ridges show a number of thin veins.

Key-words—*Cheirophyllum maithyi*, Early Permian, Pench Valley Coalfield, Satpura Gondwana Basin, India.

पेंच घाटी कोयलाक्षेत्र, सतपुड़ा गोंडवाना द्रोणी, भारत के प्रारंभिक पर्मियन से प्राप्त *कायरोफिल्लम मैथयाई* नवजाति

एस एस के पिल्लै

सारांश

पेंच पूर्वी आनति भूमिगत परियोजना, पेंच घाटी कोयलाक्षेत्र, सतपुड़ा गोंडवाना द्रोणी, मध्य प्रदेश से *कायरोफ़िल्लम* वंश की नवीन जाति *सी. मैथयाई* वर्णित की गई है। जाति शीर्ष पालि, कुंठाग्र शीर्ष की गैर-मौजूदगी और कटकों की मौजूदगी से अभिलक्षणित है तथा पटल, कटकों पर खांचे बहुत-से तनु शिराएं दर्शा रहे हैं।

केत-शब्द—*कायरोफिल्लम मैथयाई*, प्रारंभिक पर्मियन, पेंच घाटी कोयलाक्षेत्र, सतपुड़ा गोंडवाना द्रोणी, भारत।

Cheirophyllum Maithyi sp. nov. do Eopermiano do Hulhífero Pench Valley, Bacia de Satpura, India

RESUMO

Uma nova espécie do gênero *Cheirophyllum* viz. *C. maithyi* é descrita a partir do projeto de sub-superfície Pench East Incline, Hulhífero Pench Valley, Bacia de Satpura, Madhya Pradesh. A espécie é caracterizada pela ausência de lobos apicais, ápice obtuso e presença de cristas e sulcos sobre a lâmina, mostrando as cristas, numerosas veias finas.

Palavras-chave—*Cheirophyllum maithyi*, Eopermiano, Hulhífero Pench Valley, Bacia de Satpura, India.

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Palaeobiodiversity of the Lower Gondwana rocks in the Korba Coalfield, Chhattisgarh, India and observations on the genus *Gangamopteris* McCoy

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ABSTRACT

Singh KJ, Saxena A & Goswami S 2012. Palaeobiodiversity of the Lower Gondwana rocks in the Korba Coalfield, Chhattisgarh, India and observations on the genus *Gangamopteris* McCoy. The Palaeobotanist 61(1): 145-163.

The Korba Coalfield occupies the south-central part of Son-Mahanadi Master basin and is situated in the Korba and Bilaspur districts of Chhattisgarh State. With five open cast mines (Gevra, Dipika, Manikpur, Kusmunda and Laxman) spreading over 530 sq. kms, this coalfield is the biggest coal producing unit in India, however it was never explored for megafloral studies. Extensive investigations were recently conducted in this coalfield to discover the fossiliferous beds in the Lower Gondwana deposits and as a result a large number of plant fossils were recovered from these collieries and their extension sites belonging to the Barakar Formation.

The complete flora includes 38 taxa, representing 13 genera of the orders Equisetales, Cordaitales and Glossopteridales. The order Glossopteridales is highly diversified with 34 taxa and the genus *Glossopteris* with 22 species dominates the flora followed by the genera *Vertebraria*, *Sakoarota* (equisetalean stems), *Cordaites*, *Dictyopteridium*, scale leaves of fertile organs, *Gangamopteris*, *Noeggerathiopsis*, *Euryphyllum* and *Rubidgea*. This is the first ever collection and record of any mega plant fossil from this coalfield. The groups Lycopodiales, Sphenophyllales, Filicales, Ginkgoales, Cycadales and Coniferales are completely absent in this area which shows that the area might not be adequately cool and humid to facilitate the growth of these shade loving under-story plants. The genus *Cordaites*, which is a northern hemisphere taxon has been reported along with Glossopteris floral elements. An equisetalean genus *Sakoarota*, described from Madagascar has been reported for the first time from the Indian Gondwana.

The genus *Gangamopteris* comprising six species, viz. *G. cyclopteroides*, *G. cyclopteroides* var. *subauriculata*, *G. angustifolia*, *G. rajaensis*, *G. clarkeana* and *Gangamopteris* **sp.** has been systematically described and discussed in this paper. The occurrence of *Rubidgea*, *Euryphyllum*, *Noeggerathiopsis*, *Cordaites* and *Gangamopteris* along with *Glossopteris* is indicative of the presence of Karharbari sediments (Early Permian=Lower Artinskian) in the lower part of the Barakar Formation exposed in the Gevra and Dipika collieries. The recovered plant assemblage indicates an Early Permian age, Lower Artinskian (Early Barakar) in the case of the Gevra and Dipika collieries and Upper Artinskian (Late Barakar) for the Manikpur, Kusmunda and Laxman collieries.

Key-words—Son-Mahanadi Basin, Barakar Formation, *Gangamopteris, Glossopteris, Rubidgea, Euryphyllum, Noeggerathiopsis, Cordaites, Sakoarota*.

कोरबा कोयलाक्षेत्र, छत्तीसगढ़, भारत में निम्न गोंडवाना चट्टानों की पुराजैवविविधता तथा *गंगामॉप्टेरिस* मैक्कॉय वंश के प्रेक्षण

कमलजीत सिंह, अंजु सक्सेना एवं श्रीरुप गोस्वामी

सारांश

कोरबा कोयलाक्षेत्र सोन-महानदी मास्टर द्रोणी का दक्षिण-मध्य भाग घेरे हुए है तथा छत्तीसगढ़ राज्य के कोरबा एवं बिलासपुर जिलों में स्थित है। 530 वर्ग किमी से अधिक में विस्तृत पांच विवृत खान (गेव्रा, दीपिका, मानिकपुर, कुसमुंडा एवं लक्ष्मण), यह कोयलाक्षेत्र भारत में सर्वाधिक कोयला उत्पादी इकाई है, लेकिन स्थूलपुष्पी अध्ययनों हेतु ये कभी अन्वेषित नहीं की गई। इस कोयला क्षेत्र में निचले गोंडवाना निक्षेपों में जीवाश्मी संस्तरों की खोज के लिए हाल में गहन अन्वेषण किए गए जिसके परिणाम स्वरुप इन कोयला खदानों में तथा बराकार शैलसमूह के इनके विस्तारण स्थलों में बड़ी संख्या में पादप जीवाश्म मिले।

एक्वीसीटेल्ज़, कॉर्डाइटेल्स एवं ग्लोसोप्टेरीडेल्ज़ वर्गों के 13 वंशों को निरुपित करते हुए समूची वनस्पति-जात में 38 टैक्सा हैं। 34 टैक्सा सहित ग्लोसोप्टेरीडेल्ज़ प्रमुख रुप से विविधरुपायित है *वर्टिब्रेरिया, सकोएरोटा (इक्वीसिटेलियन तना), कॉर्डाइटिज़, डिक्टीओप्टेरिडियम,* उर्वर अंगों के शल्क पत्रों, *गंगामॉप्टेरिस, नैग्गेरैथिऑप्सिस, इयुरीफिल्लम व रुबीडजिया*के अनुगामी 22 जातियों सहित *ग्लोसोप्टेरिस* वंश वनस्पति-जात पर प्रभुत्व रखता है। इस कोयलाक्षेत्रा से किसी भी स्थूल पादप जीवाश्म का अबतक का यह पहला संग्रहण एवं अभिलेख है। इस क्षेत्र में लायकोपोडीएल्ज़, स्फीनोफायलेल्ज़, फिलिकेल्ज, गिंकगोएल्ज़, साइकेडेल्ज़ एवं कोनीफेरल्ज़ समूह पूर्णरुपेण नदारद हैं जो दर्शाता है कि क्षेत्र इन छाया स्नेही छोटे पौधों की बढ़वार में पर्याप्त रुप से शीत एवं आर्द्र सुसाध्य नहीं रहा होगा। *कॉर्डाइटिज़* वंश जो कि उत्तरी अर्धगोला टैक्सान है ग्लोसोप्टेरिस पुष्पी तत्वों के साथ मिली है। मडगास्कर से वर्णितइक्वीसिटेरिलयन वंश *सकोएरोटा* भारतीय गोंडवाना से पहली बार वर्णित किया गया है।

छः जाति अर्थात *जी. सायक्लोप्टेरॉइडिस, जी. सायक्लोप्टेरॉइडिस* प्रकार *सबऑरिक्यूलेटा, जी. अंगस्टिफोलिया, जी. राजोन्सिस, जी. क्लार्केएना* एवं *गंगामॉप्टेरिस* जाति सन्निहित *गंगामॉप्टेरिस* वंश इस शोध-पत्र में क्रमबद्ध रुप से वर्णित व चर्चित है। गेव्रा एवं दीपिका कोयला खदानों में बराकार शैलसमूह के निम्न भाग में अनावरित *रुबीडजीया, इयुरीफिल्लम, नौग्गेराथिऑप्सिस, कॉर्डाइटिज़*एवं *ग्लोसोप्टेरिस* के साथ *गंगामॉप्टेरिस*की प्राप्ति करहरबारी अवसादों (प्रारंभिक पर्मियन = निम्न अर्टीन्सकीयन) की विद्यमानता का द्योतक है। प्राप्त समुच्चय गेव्रा एवं दीपिका कोयलाखदानों के मामलेमें प्रारंभिक पर्मियन आयु, निम्न अर्टीन्सकीयन (प्रारंभिक बराकार) तथा मानिकपुर, कुसमुंडा व लक्ष्मण कोयलाखदानों हेतु ऊपरी अर्टीन्सकीयन (अंतिम बराकार) दर्शाती है।

संकेत-शब्द—सोन-महानदी द्रोणी, बराकार शैलसमूह, *गंगामॉप्टेरिस, ग्लोसोप्टेरिस, रुबीडजीया, इयुरीफायल्लम, नोएग्गेराथिऑप्सिस, कॉर्डेर्टिस, सकोरेवा*

Palaeobiodiversidade das rochas do Gondwana Inferior no Hulhífero Korba, Chhattisgarh, India e observações no gênero *Gangamopteris* Mccoy

RESUMO

O hulhífero Korba ocupa a parte centro-sul da bacia Son-Mahanadi Master e situa-se nos distritos de Korba e Bilaspur no Estado de Chhattisgarh. Com cinco minas de carvão a céu aberto (Gevra, Dipika, Manikpur, Kusumunda and Laxman), ocupando uma área de 530km^2, este jazigo é a maior unidade produtora de carvão na Índia, no entanto, nunca foi explorado para estudos megaflorísticos. Extensas investigações foram recentemente realizadas neste hulhífero para descobrir os leitos fossilíferos nos depósitos do gondwana inferior e, como resultado, um grande número de fitofósseis foram coletados nestas minas e em extensões de seus níveis pertencentes a Formação Barakar.

A flora completa inclui 38 táxons, representando 13 gêneros das ordens Equisetales, Cordaitales e Glossopteridales. A Ordem Glossopteridales é altamente diversificada, com 34 táxons e o gênero Glossopteris, com 22 espécies , dominam a flora seguida pelo gênero *Vertebraria*, *Sakoarota* (caules de Equisetales), *Cordaites*, *Dictyopteridium*, escamas foliares de órgãos férteis *Gangamopteris*, *Noeggerathiopsis*, *Euryphyllum* e *Rubidgea*. Esta é a primeira coleta e registro de macrofitofósseis feitos neste jazigo. Os grupos Lycopodiales, Sphenophyllales, Filicales, Ginkgoales, Cycadales e Coniferales são completamente ausentes nesta região, o que mostra que esta área talvez não tenha sido adequadamente fria e úmida para facilitar o crescimento de plantas do sub-bosque amantes da sombra (esciófitas). O gênero Cordaite, que é um taxon do hemisfério norte tem sido relatado com elementos da flora de Glossopteris. O gênero equisetaleano *Sakoarota*, descrito para Madagascar foi relatado pela primeira vez no Gondwana Indiano. O gênero *Gangamopteris,* que compreende seis especies, a saber *G. cyclopteroides*, *G. cyclopteroides* var. *subauriculata*, *G. angustifolia*, *G. rajaensis*, *G. clarkeana* e *Gangamopteris* sp., foi sistematicamente descrito discutido neste trabalho. A ocorrência de *Rubidgea*, *Euryphyllum*, *Noeggerathiopsis*, *Cordaites* e *Gangamopteris* junto com *Glossopteris* é o indicativo da presença de sedimentos Karharbari (Eopermiano=Artiskiano Inferior) na parte inferior da Formação Barakar, expostas nas minas de carvão de Gevra e Dopika. A assembléia de planta vegetal coletada indicam uma idade eopermiana, Artinskiano inferior (Eo Barakar) no caso das minas de Gevra e Dipika e Artinskiano Superior (Neo Barakar) para as minas de carvão de Manikpur, Kusumunda e Laxman.

Palavras-chave—Bacia Son-Mahanadi, Formação Barakar, *Gangamopteris*, *Glossopteris, Rubidgea, Euryphyllum, Noeggerathiopsis, Cordaites,Sakoarota*.

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Palynomorphs of Gondwanic affinities in the Oligo-Miocene sediments of Kargil Molasse Group, Ladakh, India

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ABSTRACT

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The Kargil Molasse Group of northwest Ladakh Himalaya is divided into Kargil, Tharumsa and Pashkyum formations, composed mainly of sandstone, mudstone, siliceous clay and grey to dark brown carbonaceous shale. Plant fossils recorded in these sequences are represented by angiosperm leaf impressions, pteridophytic spores, gymnosperm and angiosperm pollen grains, algal and fungal remains and gyrogonites of charophytes. The present study deals with reworked palynoflora of Gondwanic affinity of late Permian (Tatarian) and early Triassic (Scythian) age embodied in the late Cenozoic sediments of Tharumsa Formation of northwest Himalaya. The occurrence of reworked palynomorphs in the younger sediments is very significant. It can be interpreted that Palaeozoic and Mesozoic Tethyan sediments, deposited along the northern margin of Indian Plate, were transported and eroded and eventually got accumulated in the Tharumsa Formation during the process of orogenesis in this region.

Key-words—Reworked palynomorphs, Kargil Molasse, Tharumsa Formation, Miocene, Ladakh.

कारगिल मोलास समूह, लद्दाख, भारत के अल्प-मध्यनूतन अवसादों में गोंडवानी बंधुताओं के परागाणुसंरुप

माधव कुमार, अमित के. घोष, राम अवतार एवं आर.सी. मेहरोत्रा

सारांश

उत्तर पश्चिम लद्दाख हिमालय का कारगिल मोलास समूह के घटक कारगिल, तरुम्सा एवं पश्क्यूम शैल मुख्यतः बालुकाश्म, पंकाश्म, सिलिकामय मृत्तिका एवं धूसर से गहरे भूरे कार्बनिक शैल संलक्षणों से युक्त है। इन संलक्षणित अनुक्रम में आवृतबीजी पत्ती छापें, टैरिडोफाइट बीजाणु, अनावृत एवं आवृतबीज परागकण, शैवाल, कवक तथा कैरोफाइट गाइरोगोनाईट समाहित हैं। प्रस्तुत अध्ययन इन तरुम्सा शैलसमूह के समयोत्तर नूतनजीवी अवसादों में समाहित अंतिम पर्मियन (ततारियन) एवं प्रारंभिक ट्राइऐसिक (सायथियन) परागकणों व बीजाणु तथा उनकी गोंडवानिक समानता तथा उनकी पुनः चक्रण प्रक्रिया को प्रदर्शित करता है। इन तरुण अवसादों में पुनः चक्रत परागाणु आकृतियों की उपलब्धता अतिमहत्वपूर्ण है, जो तरुमसा शैलसमूह में पुराजीवी तथा मध्य जीवी तैथियन अवसादों की पुनः चक्रण की प्रक्रिया को प्रदर्शित करता है तथा इनका भारतीय आधार पट्टिका के उत्तरी छोर पर संचयन एवं पर्वतन की क्रियाविधि परिलक्षित करता है।

संकेत-शब्द—पुनर्रचित परागाणुसंरुप, कारगिल मोलास, तरुम्सा शैलसमूह, मध्यनूतन, लद्दाख।

Palinomorfos de afinidades Gondvânicas nos sedimentos Oligomiocenos do Grupo Molassa Kargil, Ladakh, Índia

RESUMO

O grupo Molassa Kargil do noroeste do Himalaya Ladakh está dividido nas formações Kargil, Tarumsa and Pashkyum, compostas principalmente de arenitos, argilitos, argila silicosa e folhelho carbonoso cinza a castanho escuro. Fitofósseis registrados nestas sequências são representados por impressões de folhas de angiospermas, esporos pteridofíticos, grãos de

pólen gimnospérmicos e angiospérmicos, restos de algas e fungos e girogonites de carófitas. O presente estudo trata de uma palinoflora retrabalhada, de afinidade gondvânica de idade neopermianoa (Tatariano) e eotriássica (Scytiana = Induana + Olenekiana), envolvidas por sedimentos neocenozóicos da Formação Tharumsa, noroeste do Himalaia. A ocorrência de palinomorfos retrabalhados em sedimentos mais jovens é muito significativa. Pode-se deduzir que os sedimentos mesozóicos tetianos e paleozóicos, depositados ao longo da margem norte da placa indiana, foram transportados, erodidos e, eventualmente, acumulados na Formação Tharumsa, durante o processo de orogênese nesta região.

Palavras-chave—Palinomorfos retrabalhados, Kargil Molassas, Formação Tharumsa, Mioceno, Ladakh.

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Scale leaves from the Barakar Formation of Satpura Gondwana Basin, Madhya Pradesh, India

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ABSTRACT

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Morphological and taxonomic features of dispersed sterile scale leaves collected from the Barakar Formation of Pench, Kanhan and Pathakhera coalfields of Satpura Gondwana Basin, Madhya Pradesh are described. The scale leaves are normally described as morphological types without their assignment to taxonomic status. Due to this practice, the identity and significance of the scale leaves have gone astray in the *Glossopteris* flora. The presence of large number of sterile scale leaves with different morphological features in the present assemblage has helped to discuss their structure, nature and affinity. The scale leaves have been assigned to different genera and species namely *Pantolepis indica* gen. *et* sp. nov., *Penchiolepis gondwanensis* gen. *et* sp. nov., *Penchiolepis indica* sp. nov., *Surangelepis ambarai* gen. *et* sp. nov., *Surangelepis elongatus* sp. nov. and *Utkaliolepis indica* Tiwari *et al.* 2009.

Key-words—Scale leaves, Barakar Formation, Early Permian, Satpura Gondwana Basin.

सतपुड़ा गोंडवाना द्रोणी, मध्य प्रदेश, भारत के बराकार शैलसमूह से प्राप्त शल्क पत्र

ए.के. श्रीवास्तव एवं दीपा अग्निहोत्री

सारांश

सतपुड़ा गोंडवाना द्रोणी, मध्य प्रदेश मे पेंच, कन्हान एवं पाथारवेरा कोयलाक्षेत्रों के बराकार शैलसमूह से संगृहीत परिक्षिप्त अनुर्वर शल्क पत्रों के आकारिकीय एवं वर्गिकीय लक्षण वर्णित किए गए हैं। सामान्यतः शल्क पत्र आकारिकीय प्रकारों के रुप में वगिर्कीय स्थितिनिर्धारित किए बिना वर्णित किए जाते हैं। इस प्रक्रिया की वजह से *ग्लोसोप्टेरिस* वनस्पति-जात में शल्क-पत्रों की पहचान एवं महत्ता भटकी हुई है। मौजूदा समुच्चय में भिन्न आकारिकीय लक्षणों सहित बड़ी संख्या में अनुर्वर शल्क पत्रों की विद्यमानता ने उनकी संरचना, प्रकृति एवं बंधुता की चर्चा में मदद की है। यहां वर्णित शल्क पत्र विविध वंश एवं जाति नामतः *पंतोलेपिस इंडिका* वंश एवं जाति नवम, *पेंचियोलेपिस गोंडवानेन्सिस* वंश एवं जाति नवम, *पेंचियोलेपिस इंडिका* जाति नवम, *सुरंगेलेपिस अम्बाराई* आदि वंश एवं जाति नवम, *सुरंगेलेपिस एलांगेटस* जाति नवम एवं *उत्कालियोलेपिस इंडिका* तिवारी आदि 2009 में नियत की गई हैं।

संकेत-शब्द—शल्क पत्र, बराकार शैलसमूह, प्रारंभिक पर्मियन, सतपुड़ा गोंडवाना द्रोणी।

Escamas foliares da Formação Barakar da Bacia Gondvânica de Satpura, Madhya Pradesh, Índia

RESUMO

Aqui estão descritas características morfológicas e taxonômicas de escamas foliares estéreis, dispersas, coletadas nos hulhíferos Pench, Kanhan e Pathakhera da Formação Barakar, da bacia gondvânica de Satpura, estado de Madhya. As escamas foliares são normalmente descritas como tipos morfológicos sem seu posicionamento taxonômico. Devido a esta prática, a identidade e importância destas têm sido descartadas na flora de Glossopteris. A presença de grande número de

escamas foliares estéreis com diferentes padrões morfológicos na presente assembléia tem ajudado na discussão da sua estrutura, natureza e afinidade. As escamas foliares aqui descritas foram designadas em diferentes gêneros e espécies chamados de *Pantolepis indica* gen. *et* sp. nov.**,** *Penchiolepis gondwanensis* gen. *et* sp. nov.*, Penchiolepis indica* sp. nov.*, Surangelepis ambarai* gen. *et* sp. nov.**,** *Surangelepis elongatus* sp. nov. and *Utkaliolepis indica* Tiwari *et al.* 2009.

Palavras-chave—Escamas foliares, Formação Barakar, Eopermiano, Bacia Gondvânica Satpura.