

PROCEEDINGS OF NATIONAL SEMINAR
ON
ADVANCES IN LIFE SCIENCES
IN
BOTANY

First Edition: 2016

© Editor in -chief
Dr. (Fr.) Walter de Sa

Editors

Dr. Emilia Mascarenhas and Dr. James D'Souza

Associate Editors

Dr. Maria A. A. R. Fonseca (Vice-Principal)

Ms. Wendy F. Xavier Martins

Ms. Sabina Sales e Dias

Mr. Conceicao De Souza

Ms. Maria Beatriz De Souza

Dr. Harshala Gad

DEPARTMENT OF BOTANY

Vision

*Integral and Personal growth of students, inculcating in them,
the attitude that Mother Nature is ours to use, not to abuse.*

Mission

*To protect and conserve Mother Nature for a better tomorrow
and provide advisory and consultancy services.*

@ St. Xavier'S College Mapusa-Goa

No part of this publication may be reproduced or copied in any form or by any means without prior written permission from the publishers. Published by Department of Botany St. Xavier'S College Mapusa-Goa

Co-Published by Broadway Publishing House

1st Floor, Ashirwad Bldg., Near Caculo Island, 18th June Road, Panjim-Goa.

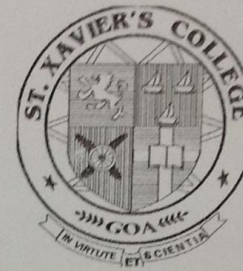
Tel: 2420677, 6647037, 6647038, Fax: 6647038

Website: www.bbcbooks.net Email: bbcbooks@rediffmail.com

ISBN: 978-93-84298-49-4

Printed by Rama Harmalkar 9326102225

Price: ₹ 495/-



PROCEEDINGS OF NATIONAL SEMINAR
ON
ADVANCES IN LIFE SCIENCES
IN
BOTANY

Organized by

DEPARTMENT OF BOTANY
St. XAVIER'S COLLEGE
MAPUSA-GOA,
403507

Awarded the status of "College with potential For Excellence"
by UGC Accredited by NAAC
with Grade "A" (CGPA Score of 3.36 on a 4 point scale)
Tel.: (off.) 91-832-2262356
Fax: 91-832-2262356
xavierscollege@bsnl.in
www.xavierscollege-goa.com

Subsurface zircons with presumptive "Biogenic" inclusions as potentially useful proxies for studying Precambrian biogenic biospheres in Goa

Dabolkar Sujata and Nandkumar Kamat*

Department of Botany,
Goa University, Taleigao,
Goa, 403206, India

*nandkamat@gmail.com

Abstract-This work was inspired by recent report by Bell et al 2015 who studied potentially biogenic carbon preserved in a 4.1 billion-year-old Zircon and need to assess the potential of Zircons found in Goa. Zircons ($ZrSiO_4$) are naturally occurring silicate minerals which show radioactivity and high ductility and contain traces of Thorium and Uranium useful in Uranium-Thorium /Thorium -230 dating techniques. Zircons can be found in igneous, metamorphic rocks, sedimentary deposits and occurs as a detrital minerals in river and beach sands. Previous reports show that the Zircons can occur in different shapes such as round, elongated and with surface characteristics (Gartner et al 2013). U-Pb Zircon dating methods had been used to study the continental growth in the western Dharwar craton of southern India (Jayananda et al., 2015). The present study was aimed at detection of subsurface Zircons with biogenic inclusions and assess their use as proxies for studying bygone Precambrian biospheres in Goa. Deep tubewell drilled Cores (60 and 65 m deep from surface) in island of Tiswadi at Taleigao were analyzed by light microscopy, Phase contrast microscopy and SEM to detect and classify the Zircons. In rapid preliminary sampling, total 50 Zircons were identified and 98% indicated the presence of interesting inclusions. These could be bubbles or kerogens or unidentified biological material. Zircons were classified as elongated, slightly rounded with sharp edges and showed widespread variety of surface characteristics like fracturing, cracks, scratches, striations and impact pits which may occur during transport processes. It is suggested that Zircons with presumptive biogenic inclusions can be further studied using techniques such as Raman Spectroscopy, Carbon Isotopic Measurements, X-Ray Microscopy, Trace Element Measurement consistent with Bell et al., 2015. More exhaustive studies have been undertaken to create a detail image database of Zircons from various other local samples to pinpoint those specifically useful for advanced work based on image analysis of the presumptive bioinclusions. Further attempts would be made to develop specific harvesting techniques to select potentially useful Zircons. International collaborations would be sought for applications of advanced techniques to local Zircons. Such studies would shed light on nature of bygone Precambrian biospheres in Goa and help in understanding evolution of life and the impact of plate tectonics and cataclysmic events shaping life on this planet.

Keywords Zircon, Precambrian, Savordem formation, Tilloid samples, Bioinclusions

Introduction

A recent report by Bell et al 2015 shows studies of potentially biogenic carbon preserved in a 4.1 billion-year-old Zircon. Zircons ($ZrSiO_4$) are naturally occurring silicate mineral show radioactivity and high ductility and contain traces of Thorium and Uranium in Uranium-Thorium /Thorium -230 dating techniques. Zircons can be found in igneous morphic rocks, sedimentary deposits and occurs as a detrital minerals in river and beach sands. Gartner et al., 2013 carried out studies on Zircons classification and classification as elongated, slightly rounded with sharp edges which showed widespread variety of characteristics like fracturing, cracks, scratches, striations and impact pits which may occur during transport processes. U-Pb Zircon dating methods had been used to study the continental growth in the western Dharwar craton of southern India (Jayananda et al., 2015). Zircons with presumptive biogenic inclusions can be further studied using techniques such as Spectroscopy, Carbon Isotopic Measurements, X-Ray Microscopy, Trace Element Measurement consistent with Bell et al., 2015. Zircons has played a prominent and complex role in interpreting the composition and history of modern and ancient sediments. Such studies shed light on nature of bygone Precambrian biospheres in Goa (Fig. 1b) and help in understanding evolution of life and the impact of plate tectonics and cataclysmic events shaping life on this planet. The aim of this study was detection of subsurface Zircons with biogenic inclusions and assess their use as proxies for studying bygone Precambrian biospheres in Goa. During this work efforts will be made to separate, classify and carry out microscopic studies of the Zircons obtained from the deep tubewell drilled Cores.

Materials and Methods

Regional geologic setting-Goa is situated in the north western part of the metallogenic Western Dharwar Craton. The Dharwar Craton is divided into Eastern and Western wherein Goa is situated in the north western part of the WDC which includes Sanvordem, Bicholim, and Vagheri Formations (Dessai 2011). Tiswadi island is a part of Sanvordem formation constituting the metagreywacke with subordinate metaconglomerate, lens samples (Dessai 2011). Deep tube well drilled Cores (60 and 65 m deep from surface) in island of Tiswadi at Taleigao were obtained from A.G Chachadi, identified as lens (Fig. 1a). Samples were powdered as shown in Fig. 2a and Fig. 2b, sieved and subjected to washing. Direct DPX mount, Scanning electron microscopy (SEM) and Light and Phase contrast microscopic studies were carried out. 24 bit mapped images processed using software (4.0.2) for following parameters: 1. Find edge function output, 2. The density function output, and 3. The surface pixel plot density (SPPD) (Velho-Pereira and Kamat 2015).

Results and Discussion

Both 60m and 65m deep core samples showed high fraction of Zircons in preliminary sampling. Total 50 zircons were identified and 98% of Zircons indicated the presence

esting inclusions. These could be bubbles or kerogens or unidentified biological materials. The sieving and floatation technique helps in enriching the fractions with zircons, which can be directly observed under light microscopy (Fig 3). The captured images of zircons were imported and converted to 24 bitmapped images using SCION image processing software (USA) beta, freeware version 4.0.2 (an image processing and analysis program for the IBM PC) to get distinct image panels for each Zircon with respective DIA output-original image, find edge function (FEF), and surface pixel plot density (SPPD). These panels are shown in Fig 4 and 5. Microscopic techniques helped in the study of presence of presumptive bio inclusions inside the zircon as shown in the Fig 6a to 6d.

The results show that using laboratory techniques and advanced image analysis software, it is possible to visualize the Zircons and bioinclusions. It is suggested that zircons with presumptive biogenic inclusions can be further studied using techniques such as Raman Spectroscopy, Carbon Isotopic Measurements, X-Ray Microscopy, Trace Element Measurements consistent with Bell et al., 2015. More exhaustive studies have been undertaken to create a detail image database of Zircons from various other local samples to pinpoint those specifically useful for advanced work based on image analysis of the presumptive bioinclusions.

Conclusion

In this work, we attempted to detect subsurface Zircons with biogenic inclusions and assess their use as proxies for studying bygone Precambrian biospheres in Goa. Further attempts would be made to develop specific harvesting techniques to select potentially useful Zircons. International collaborations would be sought for applications of advanced techniques to local zircons. Such studies would shed light on nature of bygone Precambrian biospheres in Goa and help in understanding evolution of life and the impact of plate tectonics and cataclysmic events shaping life on this planet.

Acknowledgements

We thank Anne Berger, Sales Manager, Digital Surf, France for giving permission to use Mountains Map software, for SEM image processing and analysis. This work was supported by UGC-SAP Phase II – Biodiversity, Bioprospecting programme and Goa University Fungus Culture Collection (GUFCC). We thank R.N.S. Bandekar CO, Vasco da Gama for funding the work on biomineral studies and Professor A.G Chachadi from department of Earth Science for proving core samples.

References

- Bell EA, Boehnke P, Harrison TM and Mao WL (2015). Potentially biogenic carbon preserved in a 4.1 billion-year-old zircon. *Proceedings of the National Academy of Sciences*, 112(47): 14518-14521.
- Dessai AG (2011) The geology of Goa Group: revisited. *Journal of the Geological Society of India*, 78(3): 233-242.

Järtner A, Linnemann U, Sagawe A, Hofmann M, Ullrich B and Kleber A. (2013). Morphology of zircon crystal grains in sediments—characteristics, classifications, definitions *Morphologie von Zirkonen in Sedimenten—Merkmale, Klassifikationen, Definitionen*.

Delho-Pereira S and Kamat N Digital image analysis of actinomycetes colonies as a potential aid for rapid taxonomic identification. *Nature Preceding* (2010): 1-13.

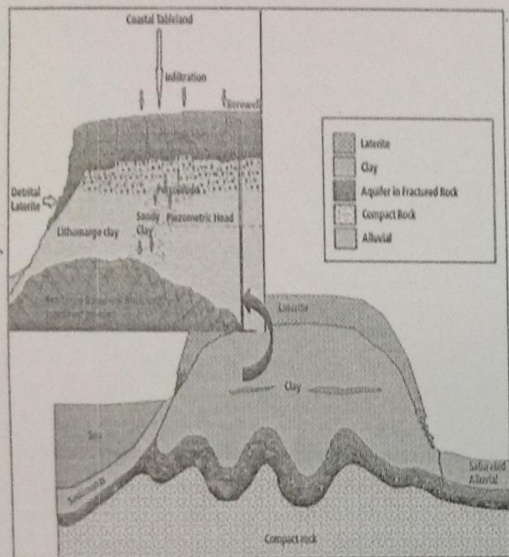


Fig1a: Geohydrological setting of tubewells drilled (Chachadi)

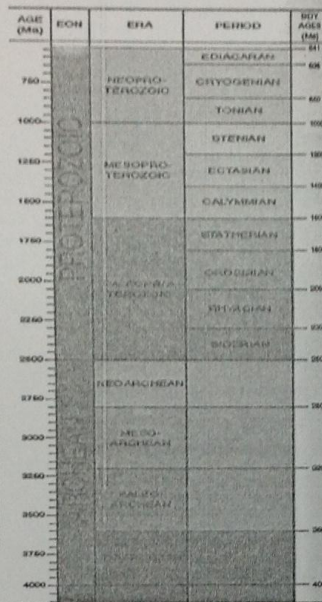


Fig1b: Geological time scale -Geological survey of America

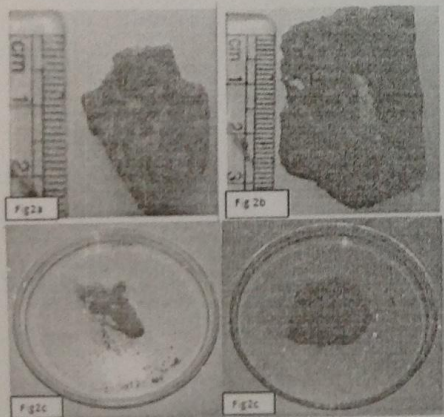


Figure 2 (a-d): a, b- 65 and 60 meter deep core Lensoid tilloid samples. C, d- Powdered tilloid samples

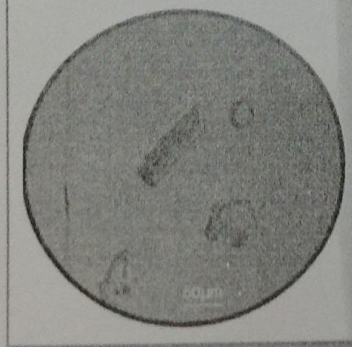


Fig 3: Mixed field showing the Zircon and other minerals

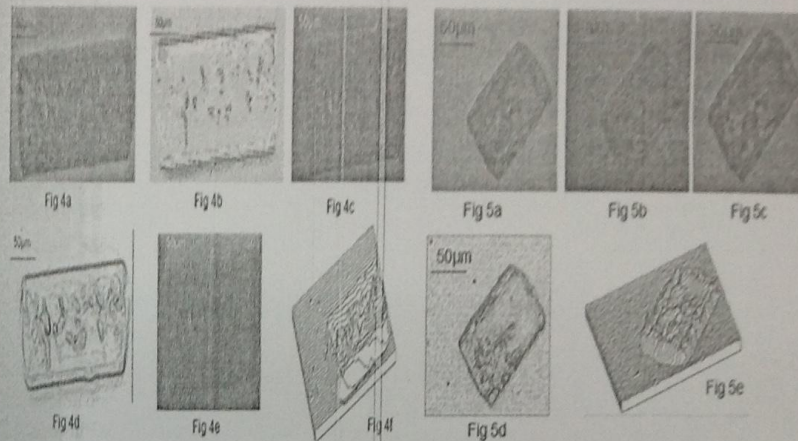


Fig 4(a-f): a-original Zircon, b- Pseudo, c-sharp edges of zircon, d-sharp edges of zircons, e-density slice, f-surface plot

Figure 5(a-e) : a-original Zircon, b- sharp edges of zircon, c-Pseudo, d-sharp edges of zircons and e-surface plot

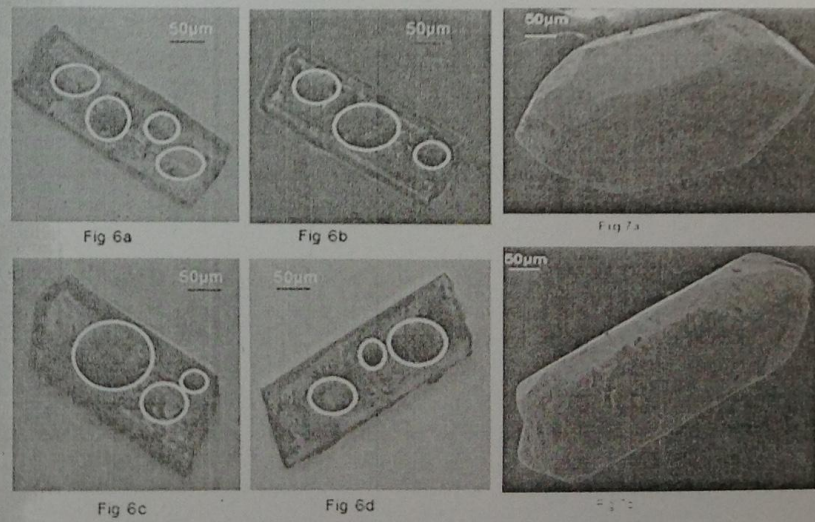


Fig6 (a-b) : Yellow circles indicate presumptive bioinclusions

Figure 7 (a-b) : SEM typology of Zircon

