

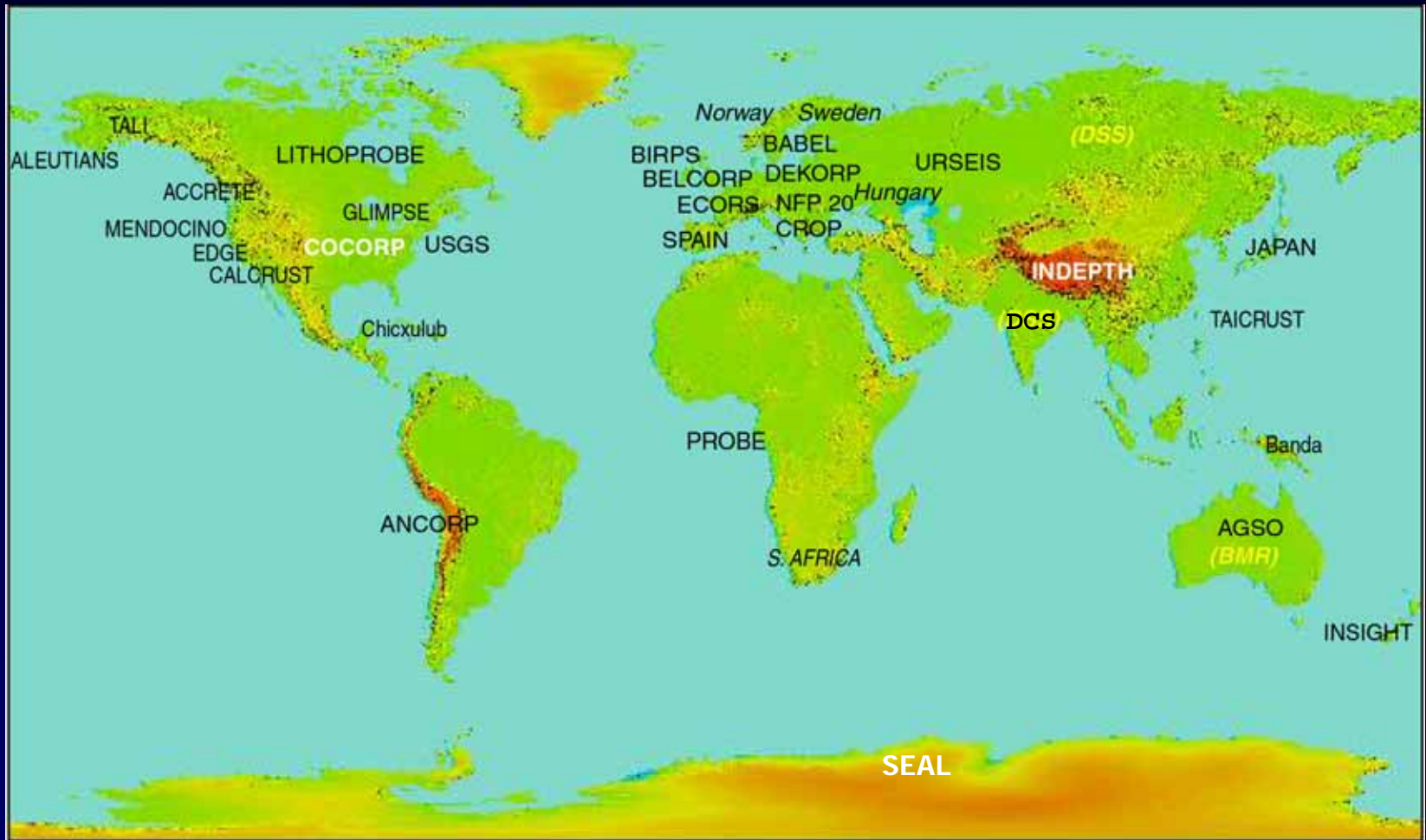
LEGENDS*

Deep Seismic Exploration of a Supercontinent

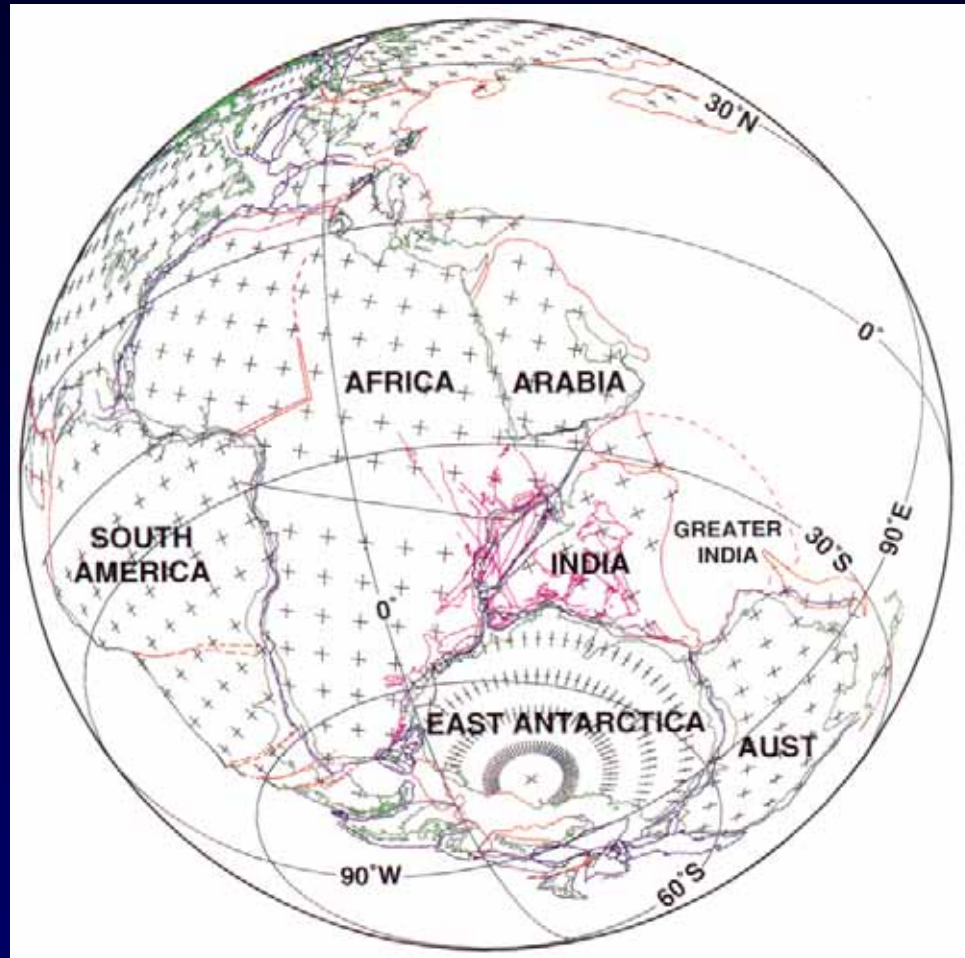
Larry Brown, Alfred Kroener,
Ramachandra Reddy, Cedric Wright
Brian Windley, Masaki Kanao

**Lithospheric Evolution of Gondwana East from
interdisciplinary Deep Surveys*

Continental Deep Seismic Reflection Profiling



The Deep Seismic Frontier

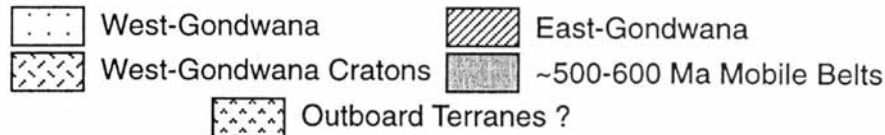
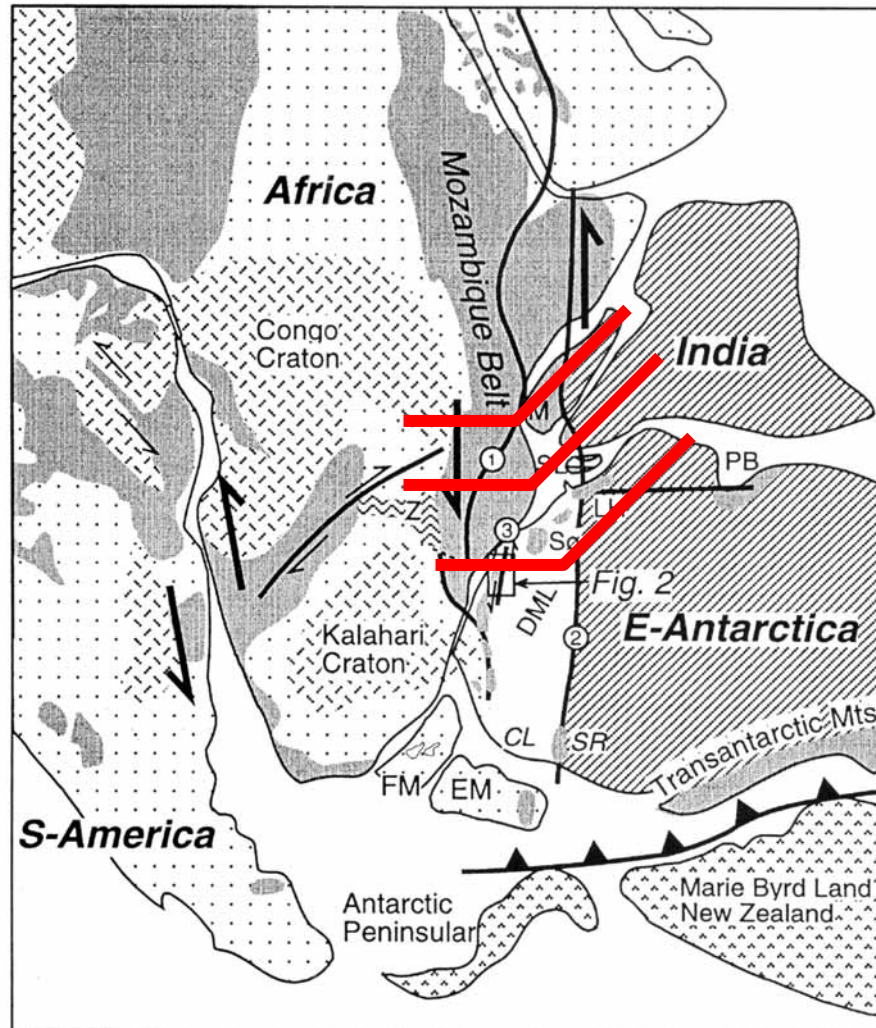


Lawver et al., 1998

Why LEGENDS?

- *Northern Hemisphere*: Deep seismic reflection profiling has cored major systematic programs of lithospheric exploration (e.g. COCORP, BIRPS, DEKORP, LITHOPROBE..EARTHSCOPE)
 - *Southern Hemisphere*: Largely unexplored by deep reflection and related techniques
 - *Gondwanaland* is the obvious intellectual organizing concept for systematic deep profiling of this frontier
 - *New geologic studies* provide firm basis for well-posed tectonic questions
 - *New technology* has reduced cost of geophysical acquisition
- *Gondwanaland* represents major, unresolved scientific issues that can be addressed by systematic program of deep studies

Amalgamation of Gondwanaland



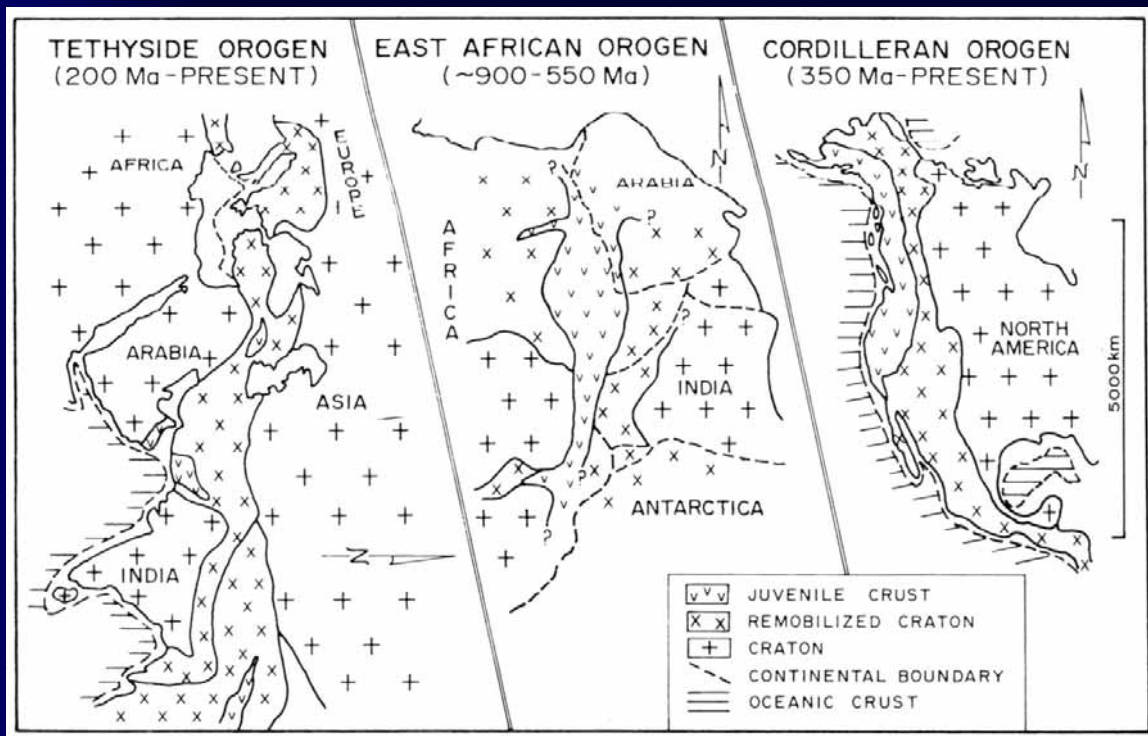
Potential
Deep Survey

After Jacobs

East African Orogen

EAO

600 ma

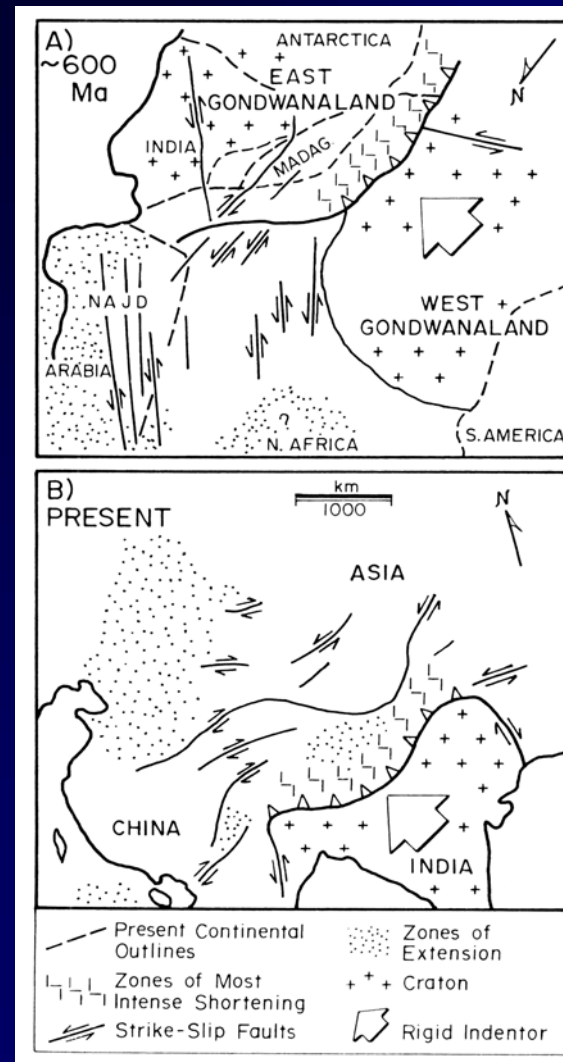


explored!

?

explored!

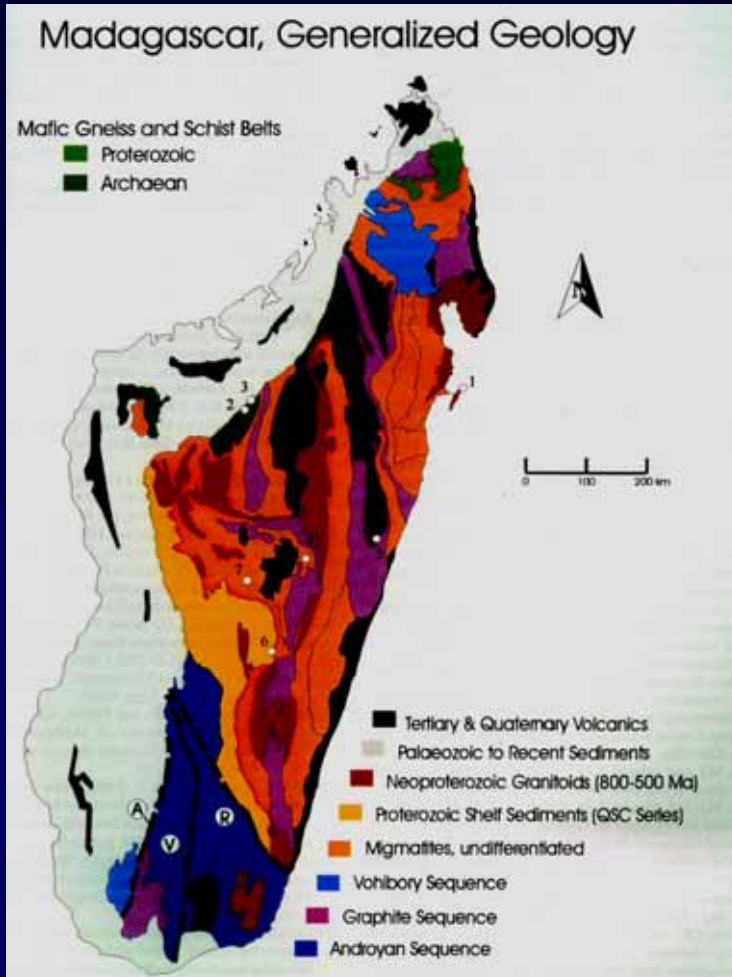
Stern, 1994



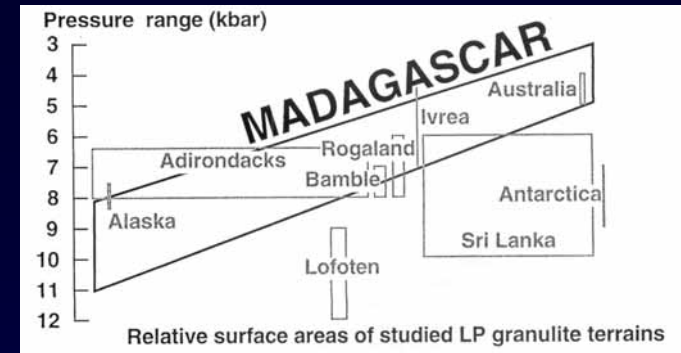
Tibet

now

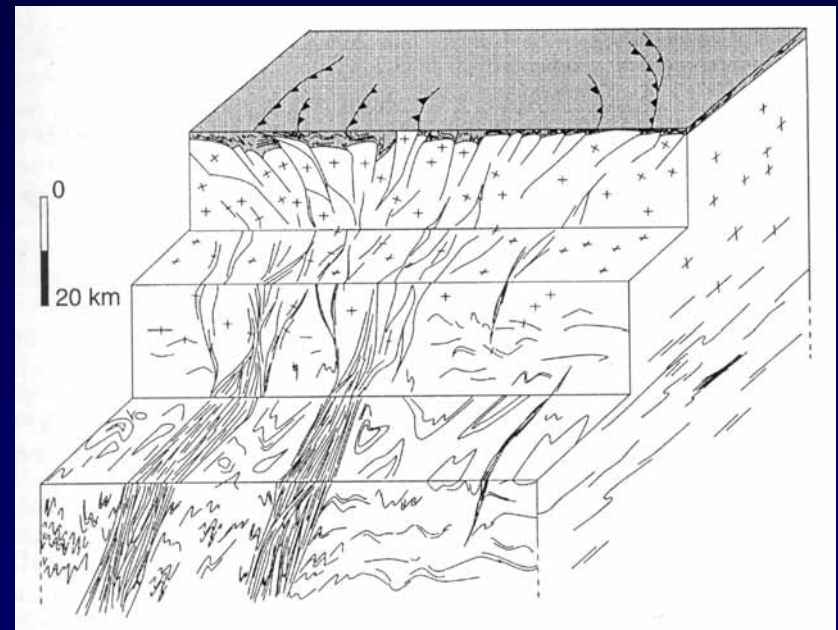
Collisional Tectonics: “Guts” Exposed



Ashwal and Tucker, 1999

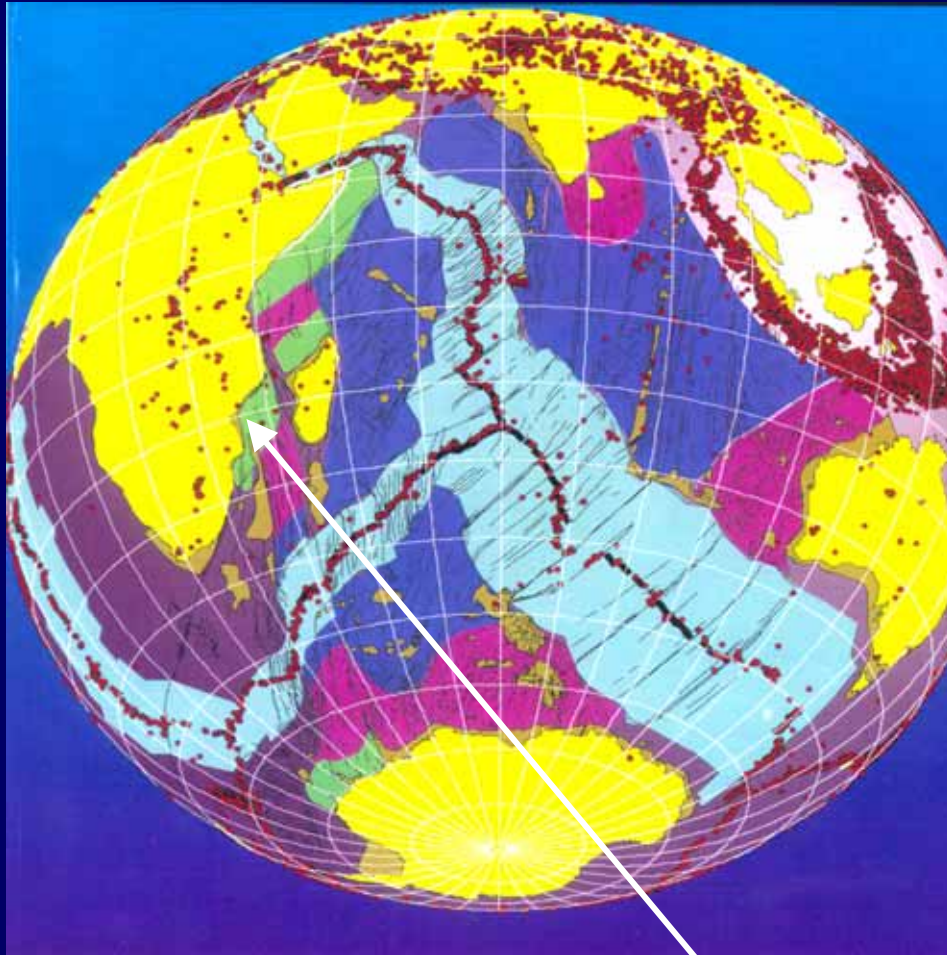


Pili et al., 1999



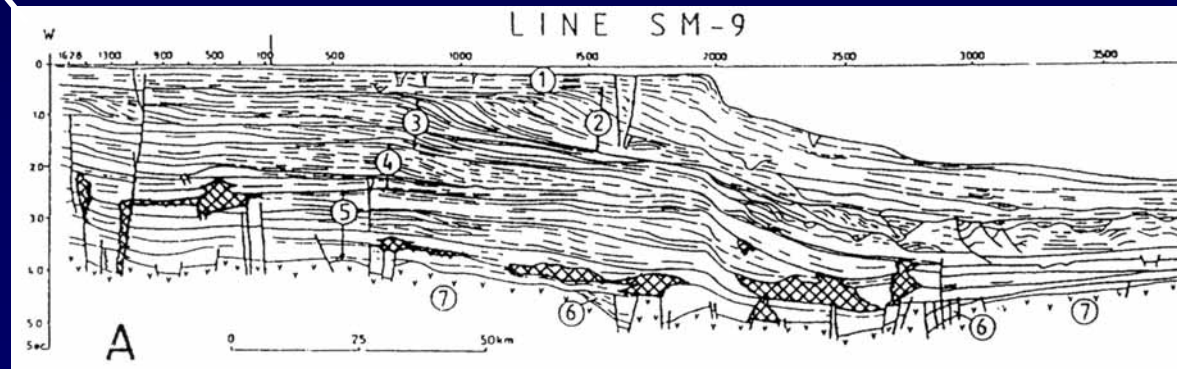
Lardeau et al., 1999

Breakup



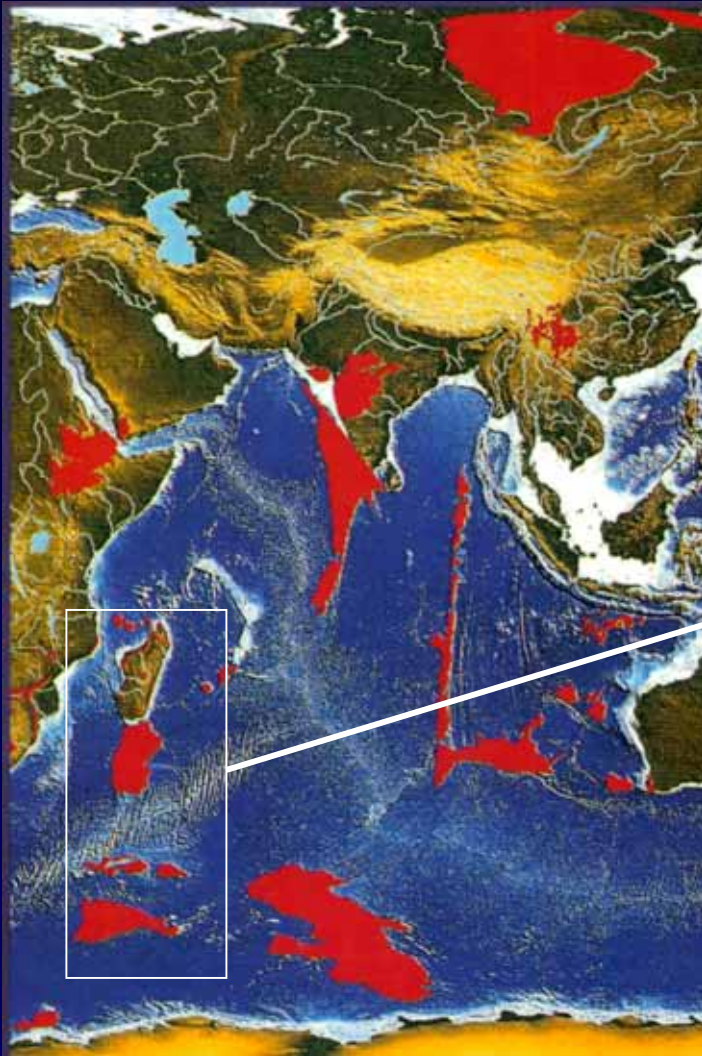
Mozambique Basin

Reeves and DeWitt (2000)

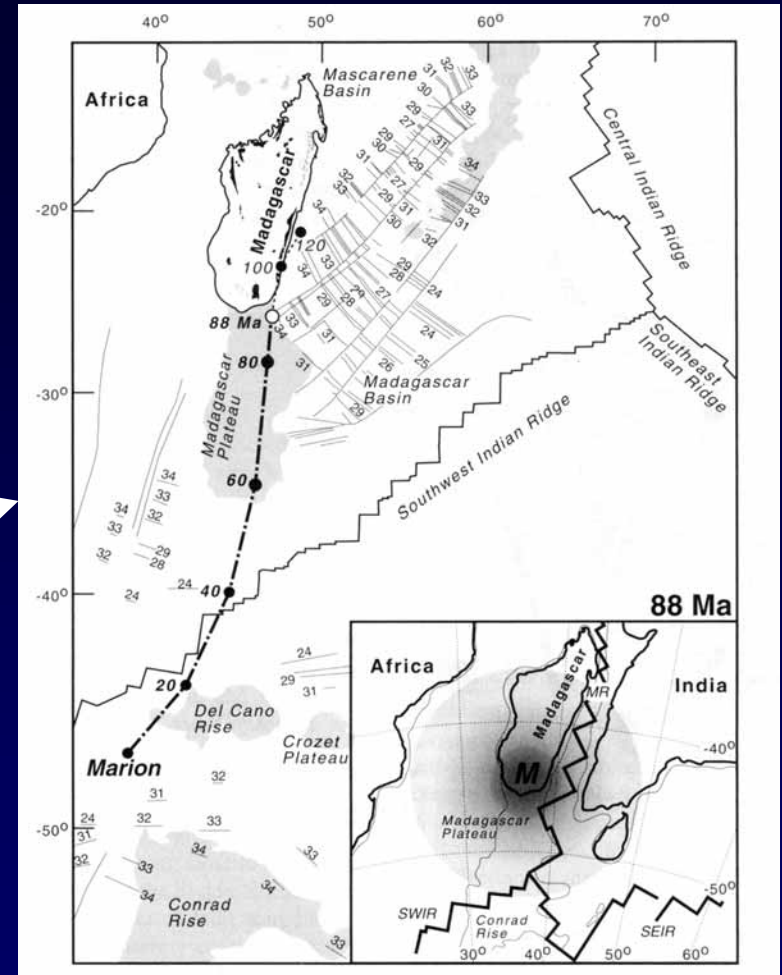


Salman and Abdula (1995)

“LIPS”, plumes and excess topo



Mahoney and Coffin (1997)

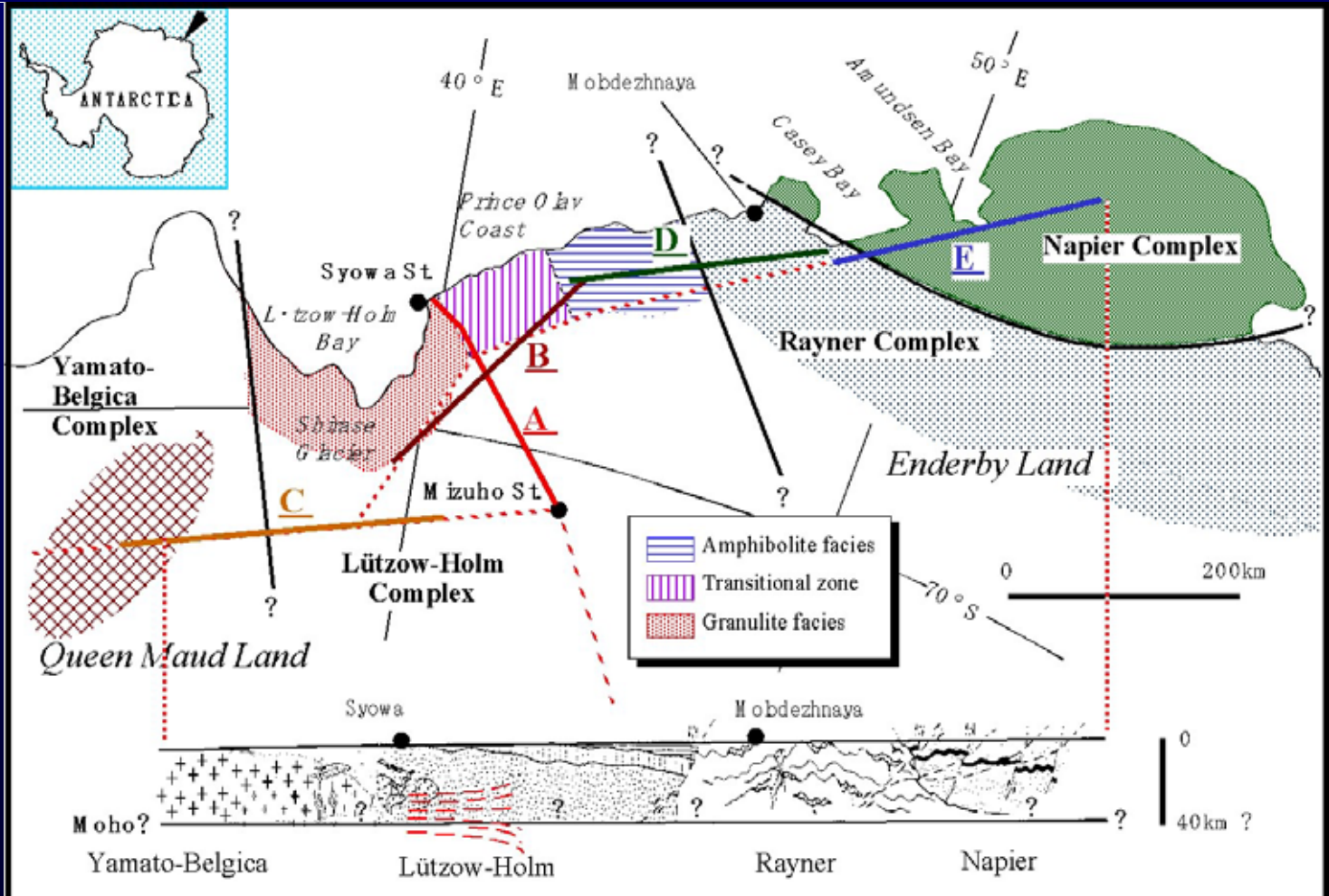


Storey et al. (1997)

LEGENDS: The Science

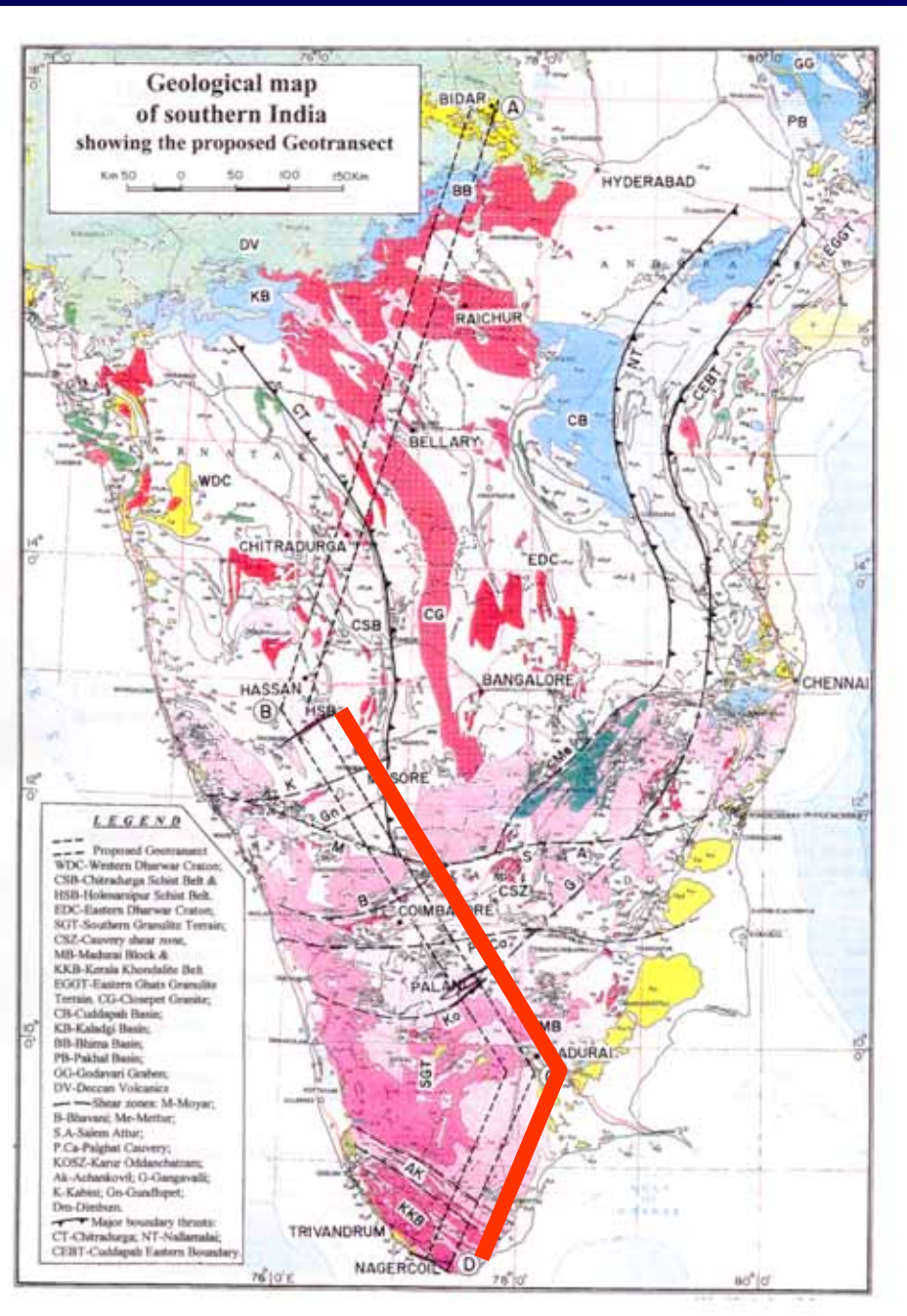
- Reconstruct Gondwana in 3D
 - e.g. where are sutures? matching deep fault geometries, reflection fabrics, velocity structure, mantle reflectivity
- Test tectonic models of continental amalgamation and breakup
 - e.g. subduction polarity, tectonic thickening, juvenile additions, post-collisional collapse
- Detail world's largest granulite terrane
 - e.g. calibrate lower crustal seismics in rest of world
- Evaluate reactivation tectonics
 - e.g. where and why does collision structure guide breakup?
- Define continental lithosphere
 - e.g. does size, geometry of “keel” match “size” of continental fragment?; how is keel related to speed of plate motion?
- Delineate tectonics of crust-mantle interaction
 - e.g. how to plumes modify lithosphere, where are the plumes?

SEAL



Geological setting and proposed refraction seismic lines in Eastern Queen Maud Land and Western Enderby Land, East Antarctica, showing the distribution of four distinct metamorphic complexes, together with the estimated geological section by Harley and Hensen (1991).

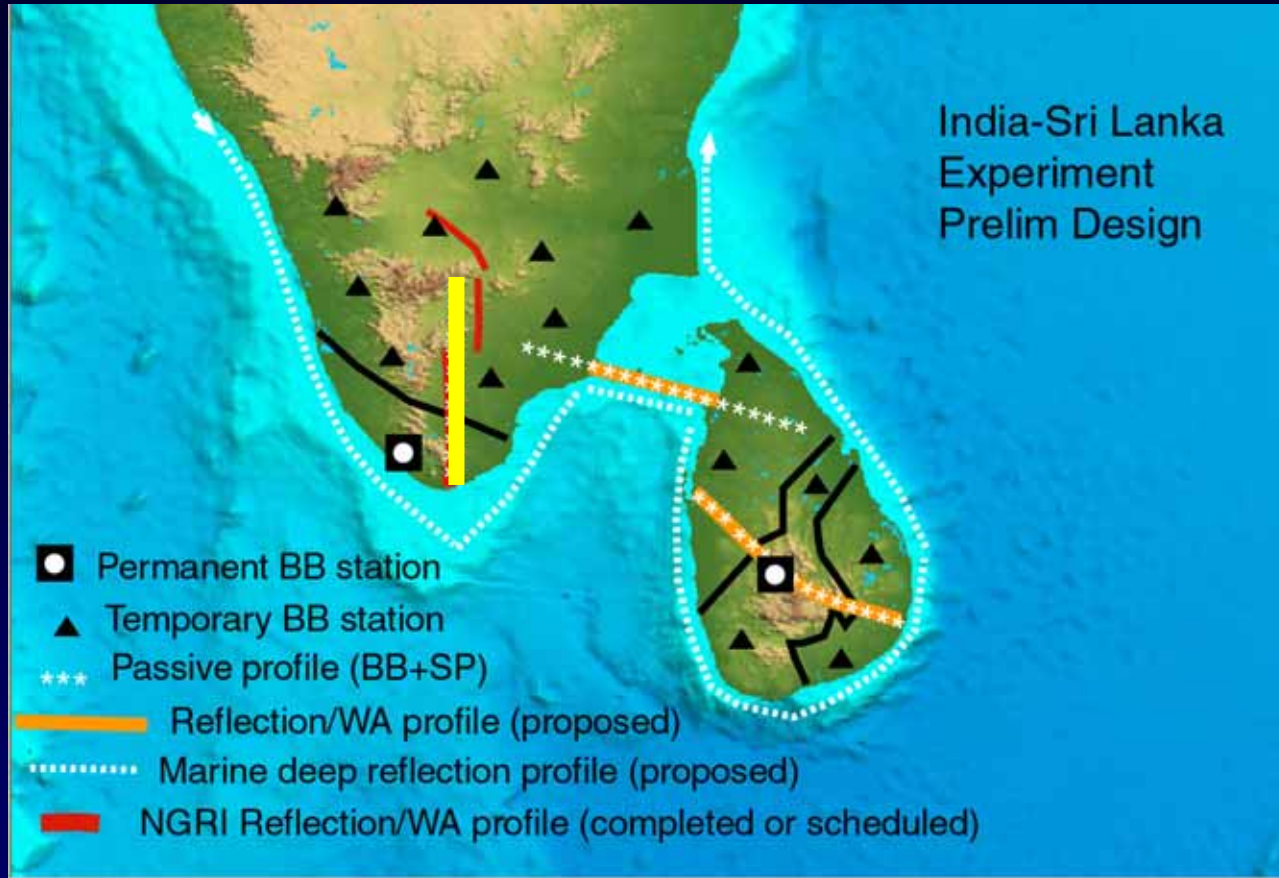
S. India Transect 2003?



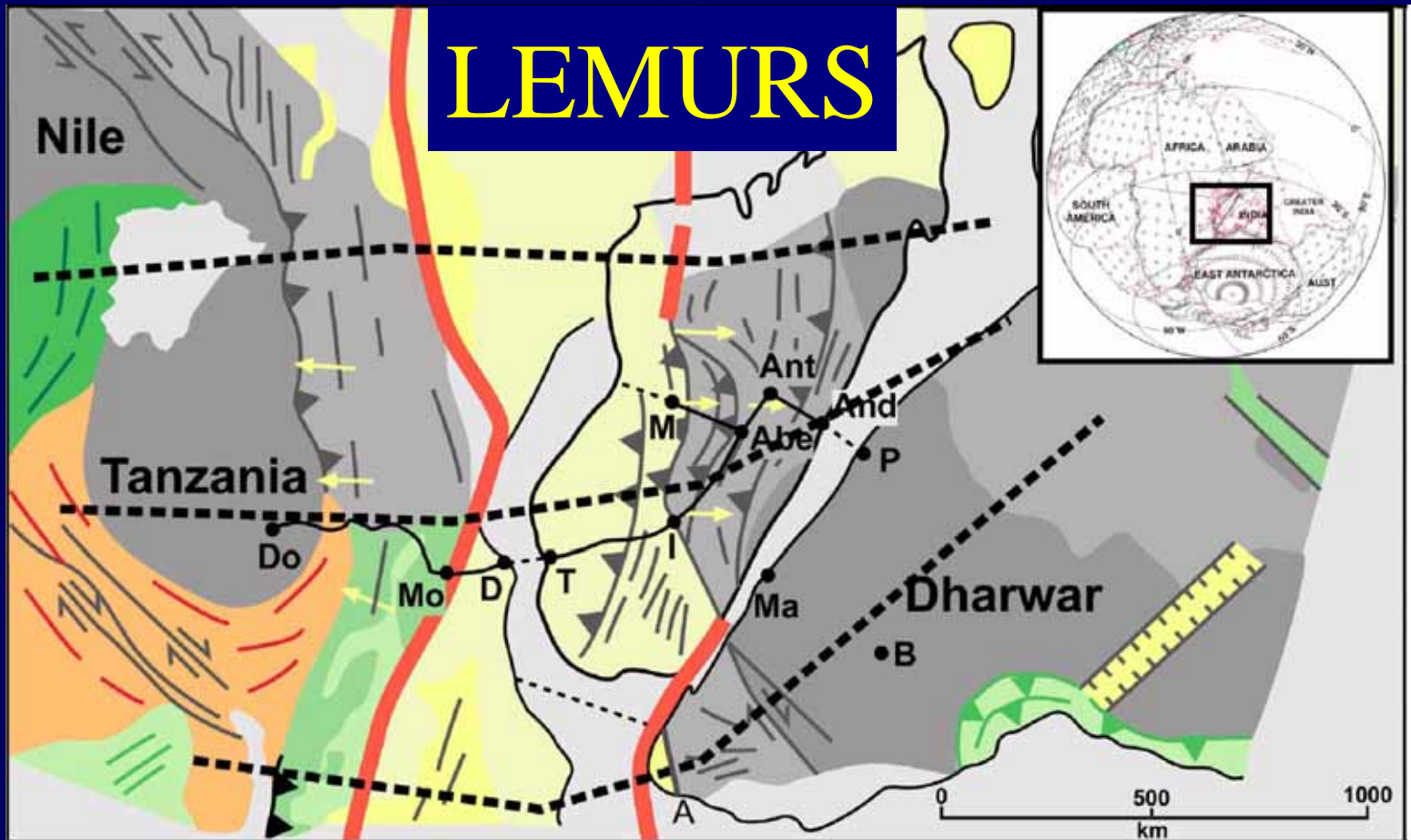
Courtesy P.R. Reddy, NGRI, Hyderabad

LEGENDS: Phase I

India-Sri Lanka



LEMURS



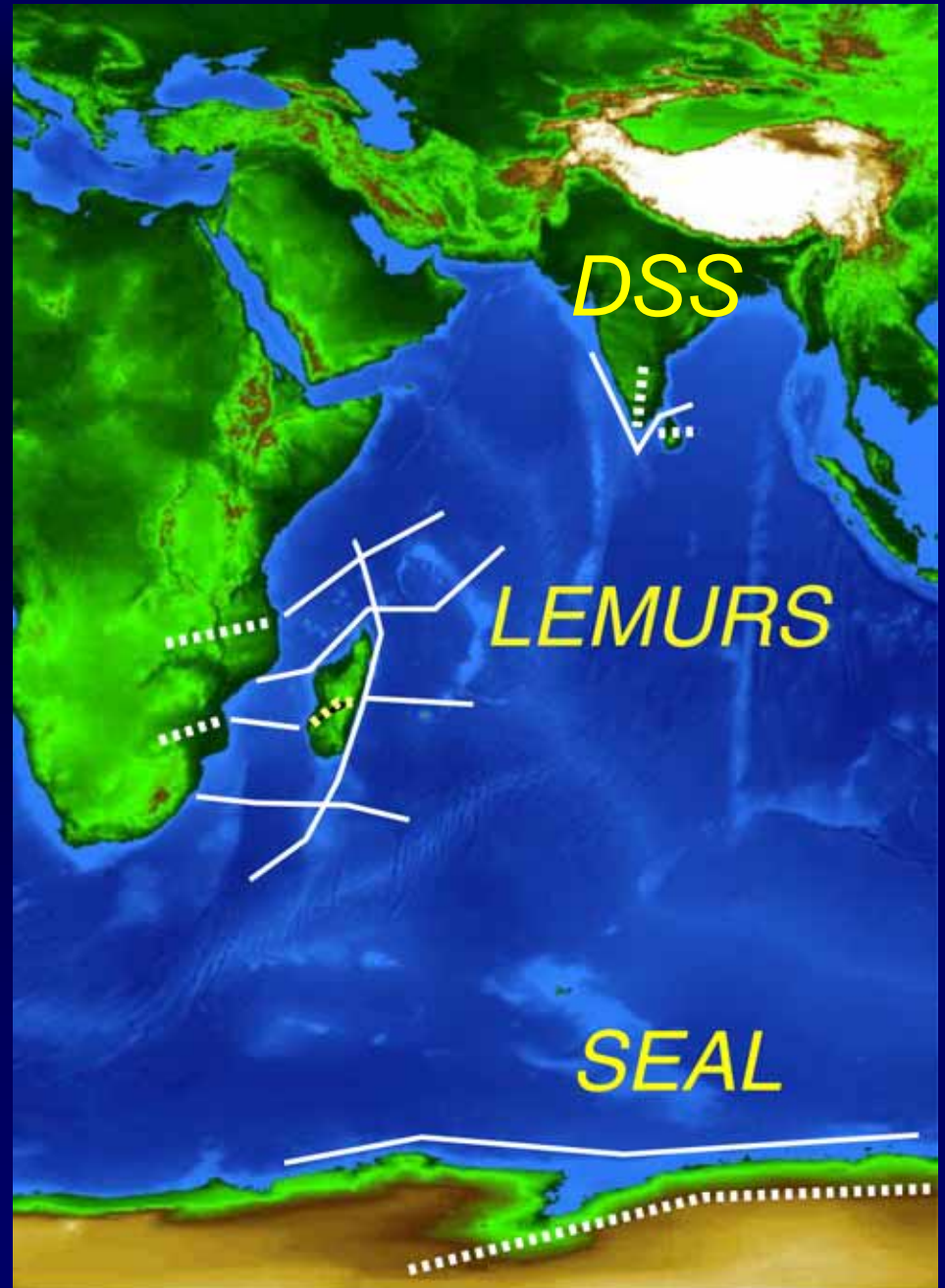
Do - Dodoma
Mo - Morogoro
D - Dar es Salaam

T - Toliara
I - Ihoso
Abe - Antsirabe
M - Miandrivazo
Ant - Antananarivo
And - Andevoranto

Ma - Mangalore
B - Bangalore
P - Panjim
A - Achankovil Shear zone

Details of the India-Madagascar-Congo fit (geotectonic map courtesy of C. Powell). Profile routes are schematic and intended to promote discussion.

LEGENDS



LEGENDS

- “World-class” geologic problems ...
- Needs systematic, international program
 - Key elements over large, multinational geographic area
 - Economy of scale
- Can exploit
 - Extensive continental margins
 - Marine deep reflection (à la BIRPS)
 - *10x less expensive than land*
 - Onshore-offshore
 - New technologies
- Existing Gondwana Geologic Infrastructure
- Political Aspects



LEGENDS: Resources

- International geological community
- Geophysical Instrument pools
 - US (IRIS), Europe (Leicester, Potsdam, Copenhagen), India (NGRI), Japan (NIPR), GAustr (Canberra)
 - **Develop special “Gondwana” pool ?**
- Seismic reflection “crews”
 - NGRI (Hyderabad),
 - GAustr (Canberra)
- Geochemistry/geochronology facilities
 - US, Europe, Australia, Japan



Support & Collaborating Organization

- LEGENDS Steering Committee was authorized by IASPEI as a sub-committee (No.CC-8) under the 'Committee on Interdisciplinary Lithospheric Surveys (COILS)', under the International Lithospheric Program (ILP), IASPEI
- Support from International Association for Gondwana Research (IAGA), under International Geological Correlation Program (IGCP), IGC.
- Support from SCAR ?

LEGENDS: Strategic Issues

- Identify/ prioritize key targets/problems
 - International workshops
- Link with other programs
 - What else is going on in the area
- Develop cost-effective field program
 - “Lean and mean”
- Develop/Coordinate funding
 - Technology transfer



Potential Funding Agencies

NSF (USA)- June 1 preproposal; Dec 1 main proposal; June 1 Start
Australia ARC Discovery Grants- close Feb; Nov. decision; Jan Start
European Funding Agencies- EU, ESF, individual countries

World Bank- (for instruments to be donated to developing countries, plus costs of training indigenous personnel in its use.

UNESCO- training funds

Commonwealth of Australia

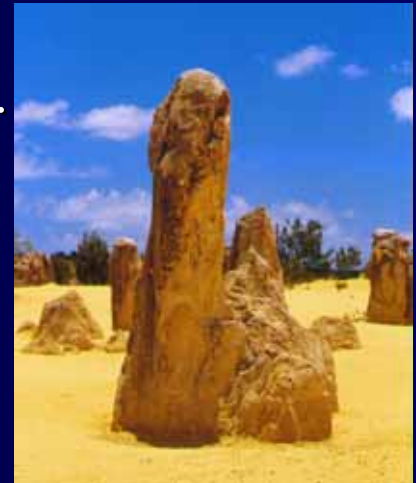
Mining companies (?)- support could be in kind with use of drill rigs and vehicles in countries of interest

Oil companies- especially those with interests in western Madagascar and the Tanzanian-Somali continental shelf

France- Marine geophysical surveys emanating from Reunion base.

Japan- 1) Japan Society for the Promotion of Science,

2) The Ministry of Education, Science, Sports and Culture



LEGENDS: A Brief History

- 1996
 - Asilomar Deep Seismic Conference (DSC)
 - COILS first proposed
- 1998
 - ILP approves COILS Coordinating Committee
- 1999
 - COILS website generated
- 2000
 - DSC Ulvik, Norway: COILS workshop
 - GSA Reno, LEGENDS formulated
- 2001
 - ILP approves LEGENDS Subcommittee
 - **"formal" presentation of LEGENDS initiative at ISRGA in Osaka (Oct. 2001)**
- 2002
 - NSF funding obtained for ELLIPSE
 - **Initial LEGENDS workshop at NGRI, Hyderabad**
 - **LEGENDS Session at EGU, Nice**
 - **LEGENDS Subcommittee established by ILP**
- 2003
 - DSC Taupo, NZ: Phase I Global Atlas
 - **LEGENDS Workshop: Kandy, Sri Lanka (Spec. Issue JAES pending)**
 - LEGENDS Workshop at EGU, Nice
 - **LEGENDS Session at IUGG, Sapporo**
 - Global Atlas workshop, SF
- 2004
 - **LEGENDS Workshop Hyderabad (with Field SGT Field Trip)**
 - DSC Mont Tremblant, Canada: Phase II Global Atlas
 - Global Atlas Website established (<http://www.earthscrust.org>)
 - **LEGENDS Session at AOGS, Singapore**
 - NGRI deep seismic survey of SGT begins
- 2005
 - Deep seismic survey of SGT completed
 - ELLIPSE website available (<http://www.geoellipse.info>)