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PRESENTATION

Reduction of Global Warm Air by Geo-sequestration of Excess CO_2

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Reduction of Global Warm Air by Geo-sequestration of Excess CO_2

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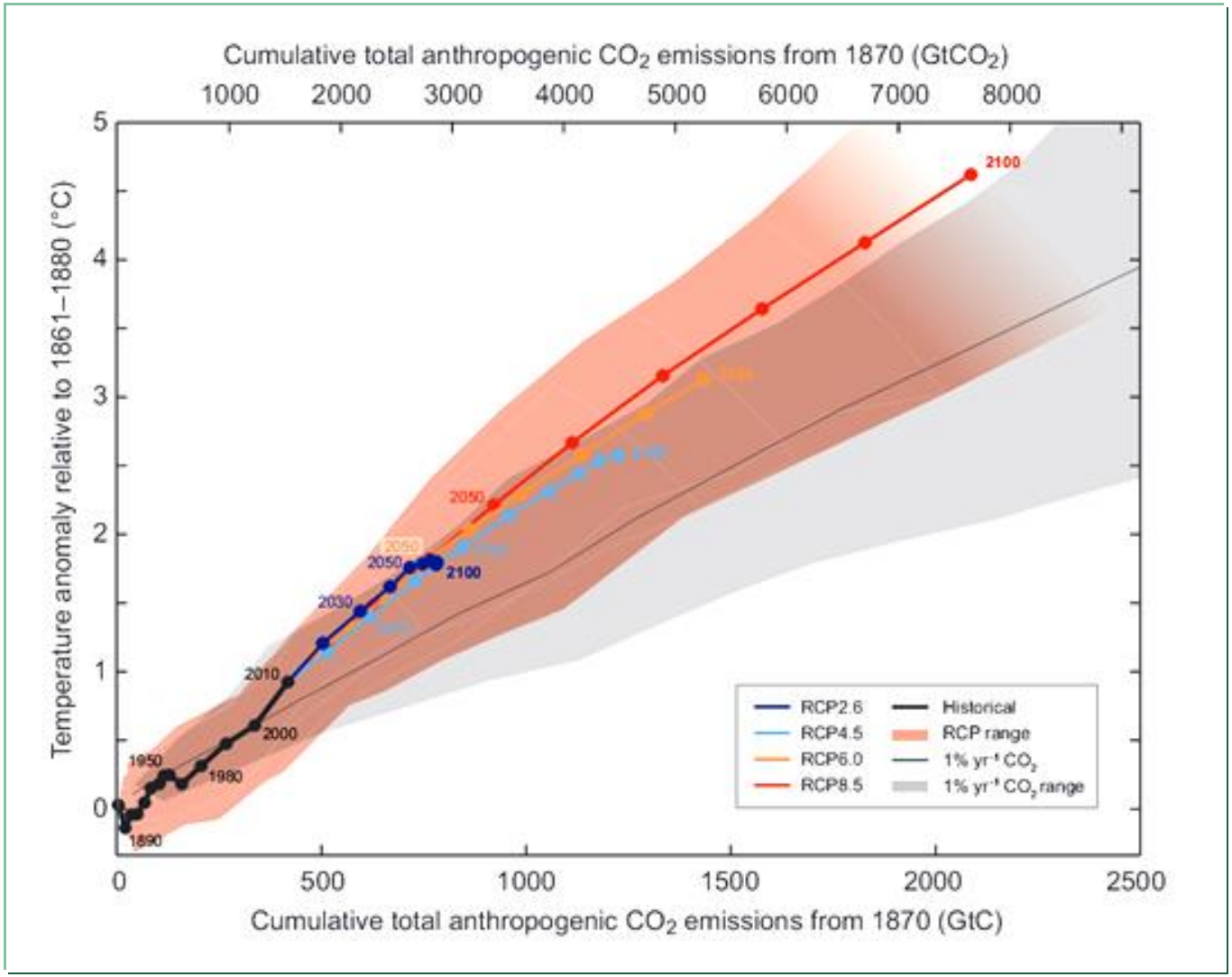
Hawa (air) & Pani (water)

Plan of the lecture

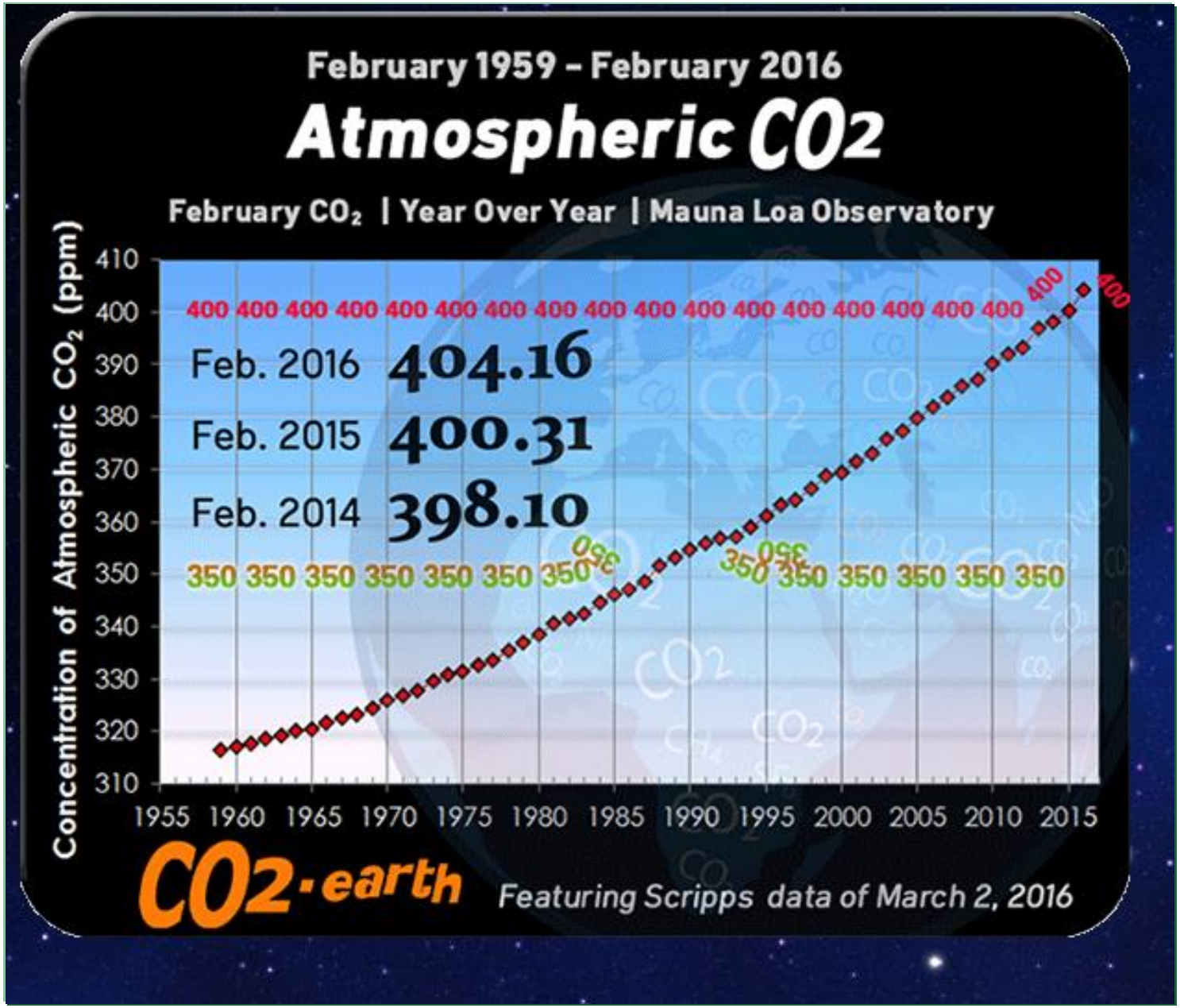
- Some Important Facts
- CO_2 and Environment
- Major Effects
- Use and Abuse
- Possible potential CO_2 traps
- EOR
- Conclusions

Some Important Facts

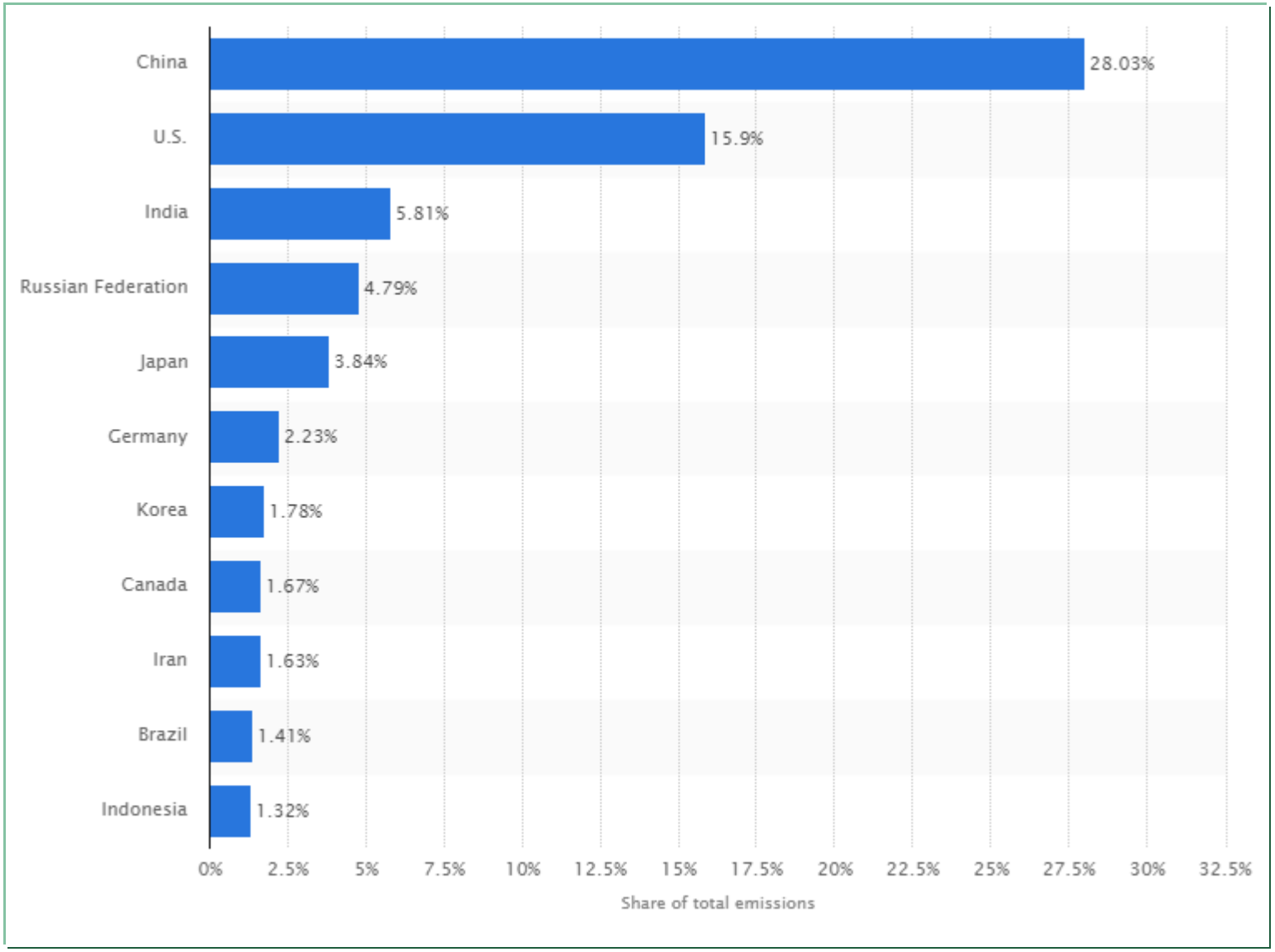


Increase of the mean Earth's surface temperature as a function of the cumulative global CO_2 emissions. Mean values calculated from multiple simulations using several carbon cycle models are shown until year 2100 for each RCP (color lines).

Seneviratne et al., Nature, 2016



Source: www.co2.earth



As per the survey done in 2015, India is third largest CO_2 emitter in the world.

- **Recent Paris meeting concludes,**

"Yet the Paris agreement seeks to limit planetary warming to well below 2 °C, urging nations to pursue an even stricter target, 1.5 °C. To put this in perspective, the average global temperature has already risen 1 °C since the start of the Industrial Revolution."

India ratifies Paris climate agreement

- India ratified the Paris Agreement on Climate Change by depositing the instrument of ratification with the United Nations on Sunday, the 147th birth anniversary of Mahatma Gandhi.

- Currently from 61 countries the total green house gas emission is about 47.79.

- India is the 62nd country to ratify the agreement, which will enter into force one month after 55 countries that account for 55 % of global emissions ratify the agreement.

- With today's action by India, which accounts for 4.1 per cent of the emissions, the Agreement only needs slightly more than 3 percentage points to reach the 55 % threshold," a U.N. statement said.

- With India and EU on board the emission share figures to reach 63.99% of total global emission before October 7th, 2016.

Hindu news paper: 03-10-2016

CO_2 and Environment

- Increasing carbon dioxide (CO_2) emission is an alarming threat to the environmental pollution - potential cause for the global warming.
- Global CO_2 concentration is raised by 25% over the last 200 years. Present concentration is around 404 ppm.

Major Effects

- Changes in Agricultural yields
- Sea level rise
- Increase of intensity of extreme weather events
- Changes in precipitation pattern & amount
- Mass species extinction
- Effects on Glaciers
- Changes in the timing of seasonal patterns in ecosystems
- Other effects of economic importance

Carbon Capture & Storage (CCS)

- Capture and storage of CO_2 in suitable place is attractive because of manifold advantages.

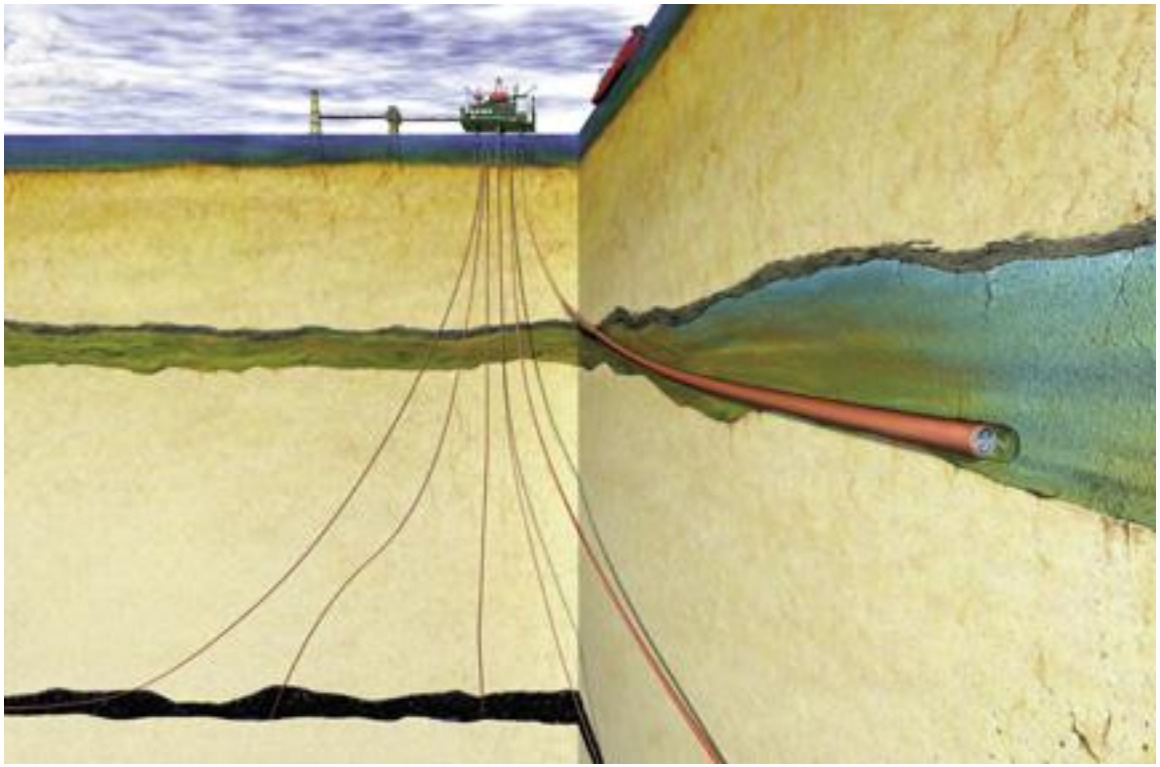
Use and Abuse

- Potential use of abused CO_2 emissions:
  - Enhanced Oil Recovery
  - Coal Bed Methane
  - Mineral Carbonation

CO_2 sequestration

- Geological sequestration of carbon dioxide is a means of its injection in a suitable geological formation.
- Typically below 1 km depth where temperature and pressure are above the critical point for carbon dioxide (31.6^0C, 7.38MPa).

Geological CO_2 sequestration



Promising traps

Geological reservoirs for safe and long storage for carbon dioxide must meet certain criteria. Some favourable geological traps based on reservoir characteristics such as porosity, permeability, and their affinity for the chemical reactions is discussed below:

1. Perfect sealing so as to preserve it for long geological time.
2. Leakage of sequestered carbon dioxide could lead to environmental disaster
3. Temperature pressure condition to initiate chemical reaction for carbonation of the minerals.
4. Suitable porosity, permeability and presence of suitable reactants like brine, are some of the criteria of good sequestration sites.

Possible potential CO_2 traps

There could be several possible traps for efficient CO_2 storage, however few known traps are discussed here:

1. Abandoned hydrocarbon reservoirs
2. Brown oil fields
3. Saline Reservoirs
4. Non-economic coal seams
5. Shale formations
6. Basalt formations

1. Abandoned hydrocarbon reservoirs

1. These are the geological settings in which oil/gas was trapped for long geological time.
2. These abandoned reservoirs are the best possible locales vacated by the natural oil and gas where carbon dioxide can be stored.

3. These reservoirs have proven capacity of holding natural oil and gas and have good sealing.

4. Under high pressure carbon dioxide turns into liquid (super critical carbon dioxide) and when injected in the reservoir it is trapped below an aquiclude or seal (cap rock).

EOR Methods

Water Flooding

Thermal Process

a. **Steam Flooding – steam injected, heats oil to flow readily**

b. **In-situ combustion (fire flooding)**

CO_2 injection

CO_2 injected, mix with oil – reduces forces that hold oil to pores, allows easily displace by injected water

Chemical recovery

Inject polymer into water phase of reservoir trap, large molecule add bulk to water, water thicken, wash oil from pores.

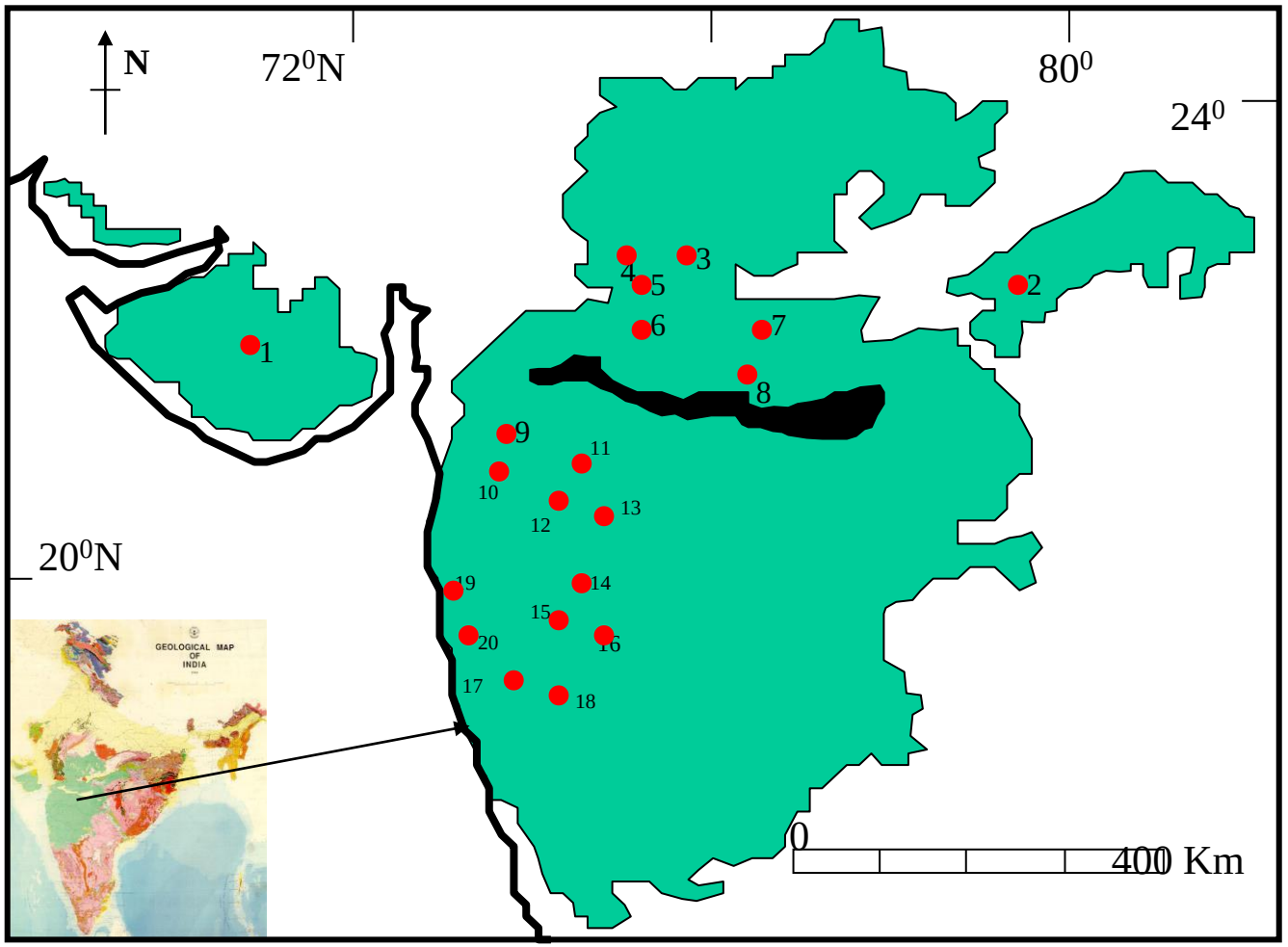
2. Brown Oil Field: Enhanced Oil Recovery

- In a brown field sequestering carbon dioxide becomes an additional advantage because it helps in enhanced oil/gas recovery.
- The injected carbon dioxide dissolves in the oil and reduces its viscosity. This is indeed one of the best known commercially viable methods to enhance the secondary recovery from the oil fields.

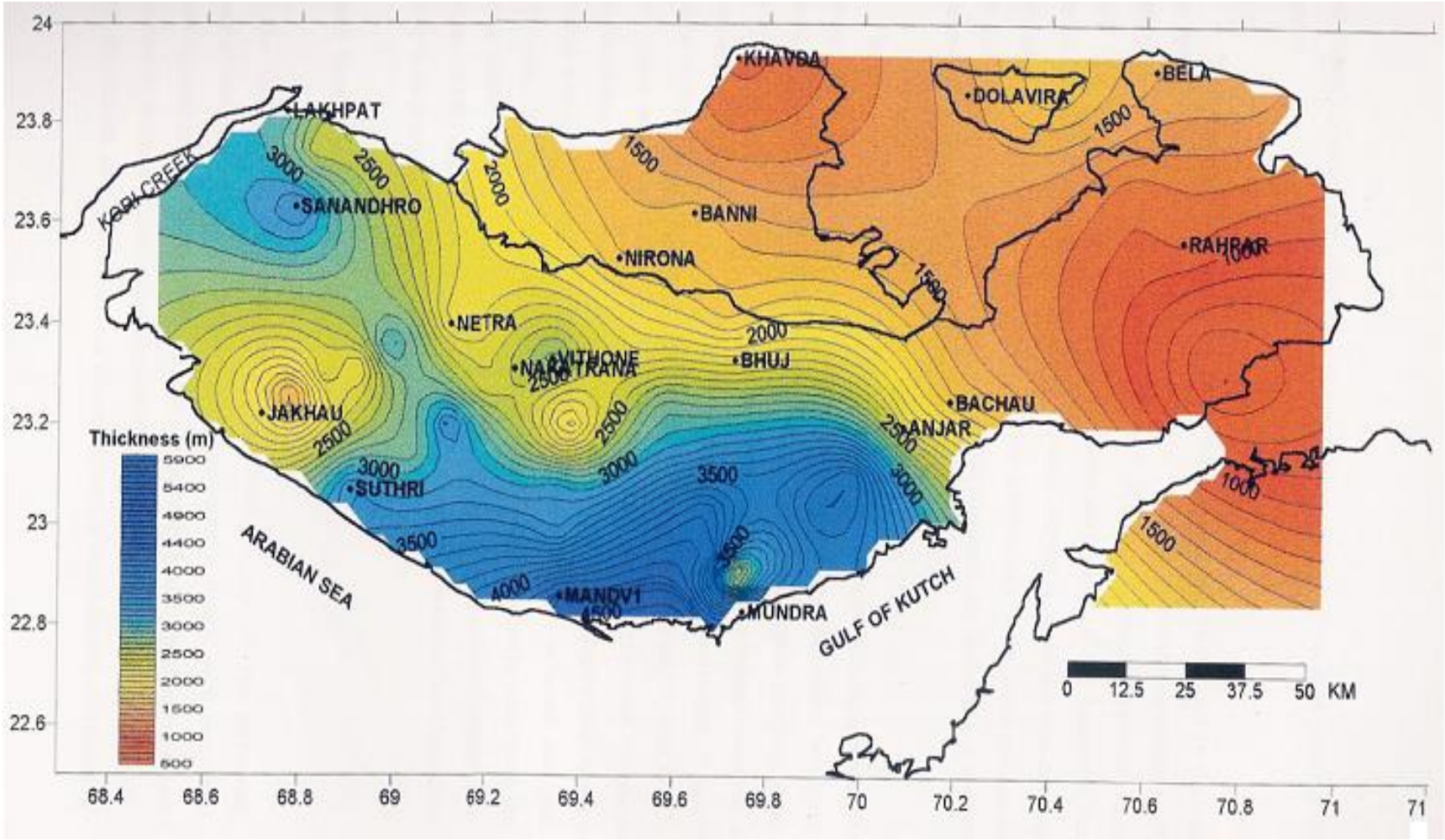
6. Basalt formations: A huge potential

- Large igneous provinces ranging in age from the Precambrian to the Recent occur throughout the world such as Columbia River basalt group in USA, Deccan Volcanic Province (DVP), India.
- More than 500,000 sq. km of the Indian Peninsula is covered under basaltic rocks, known as Deccan Volcanic Province (DVP).

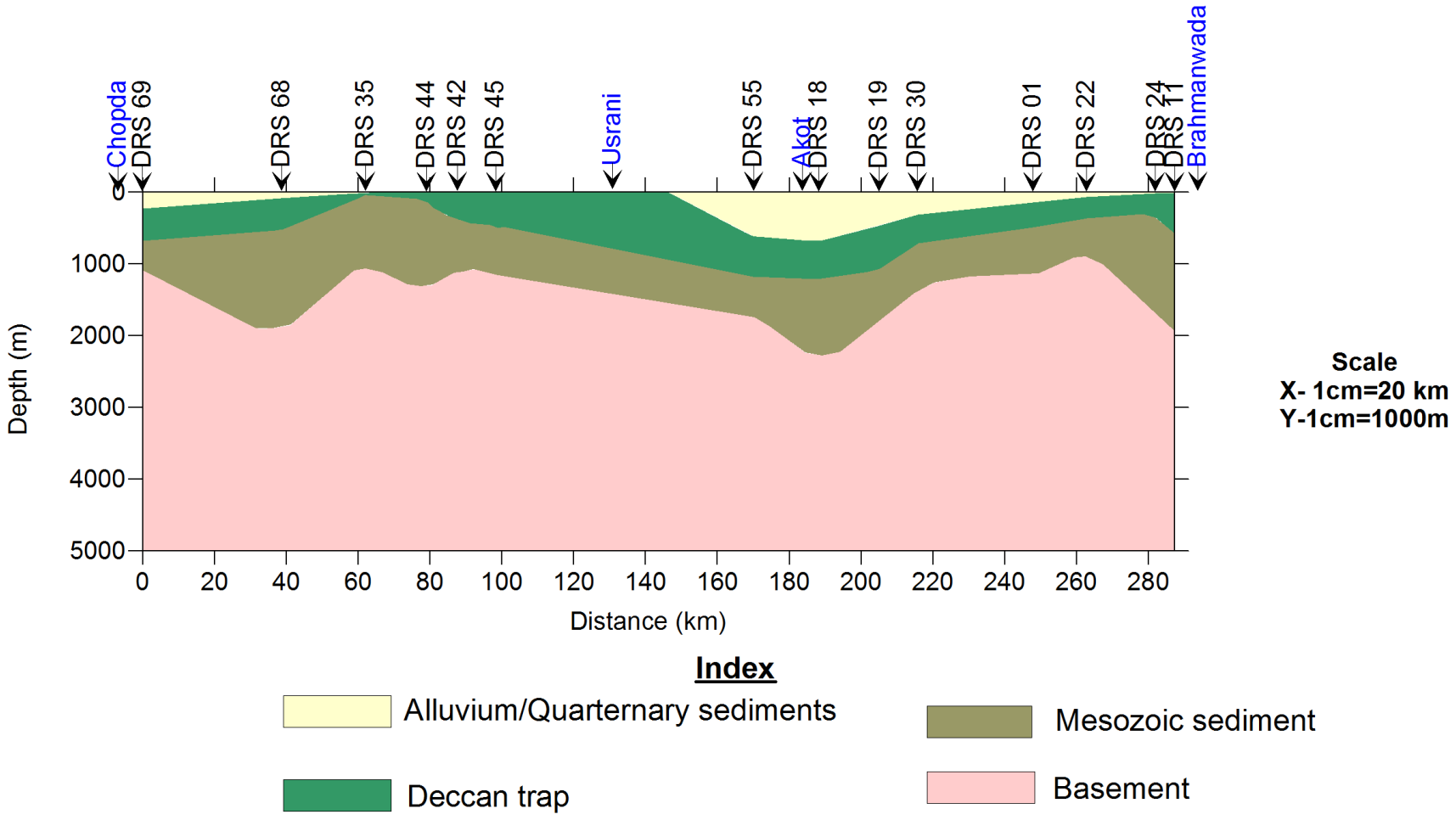
Location of the Deccan volcanic province



- Another attractive alternate zone is in the Mesozoic sediments below DVP.
- The thickness of such Mesozoic sediments has been delineated by NGRI for Oil and Natural Gas Corporation (ONGC) & Directorate General of Hydrocarbon (DGH).
- A model along the Chopda to Brahmanwada profile in Western India shows depth section of the Deccan trap and Mesozoic sediments. This has been achieved using Deep Resistivity Sounding (DRS) study of NGRI.



Mesozoic sediment thickness map, Kuchh



Cross section of the thickness map across Chopda and Brahmanwada in western India.

Conclusions

- Public awareness of detrimental effects of global warming and it's mitigation steps, is a vital part to overcome the increasing carbon dioxide.
- Measures of mitigation of Global warming must be implemented from individual to national and international level.

- Geological sequestration of carbon dioxide to reduce global warming is an active area of research.
- Abandoned hydrocarbon reservoir, saline reservoir, non-economical coal seams, shale and basalt formations are the promising candidates for carbon dioxide storage.

- Carbon dioxide injection serves two purposes, one to reduce CO2 from atmosphere and other to enhance oil recovery from brown oil fields.

Thank You