

1. Western Tectonics - Jan. 2014
2. India Physical .

PRESENTATION

Docket 1 - Tectonic Style of Western Subcontinent . Word Document .

~~Add: Docket 2 - pp Himalaya Geology Jan 2014 - pp .~~

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DOCKET 1

Tectonic Style of Western Subcontinent

Current geology of the Indian subcontinent is based on the Geological map of India prepared by the Geological Survey of India. It covers the rock outcrops observed in the country. However large parts are left uncovered, particularly the Indo gangetic plains, the coastal areas, the Bay of Bengal and the Arabian Sea. This wide gap in knowledge has been filled in by geophysical surveys of ONGC, OIL and NGRI.

It will be appreciated that geophysics is the application of measurement to geology and is therefore an extension of geological knowledge. This aspect has been widely ignored in the teaching of geology in universities and has to be remedied. As an initial contribution a series of docket are being made to describe the tectonic style of the various parts of the country and will be posted on the website. The accompanying maps form an integral part of the attempt. The current article is the first of these docket.

A full understanding of the crust requires intensive, extensive and uniform coverage of the concerned data. This condition is fully satisfied in the topographic and gravity anomaly maps of the country and partly in the Geological Map. The first attempt to produce a tectonic map based on the composite data was made in a collaboration project of ONGC and the Indian Institute of Geomagnetism. This was published in 1997 as Memoir 38 of the Geological Society of India entitled "Tectonic Elements of the Indian Subcontinent and Contiguous Areas : A Geophysical View". It includes a coloured tectonic map on a scale of 1:4000000. It has been subsequently updated and a new publication is shortly expected. *

The various maps depicting the tectonic style of the Western Subcontinent are described below.

Slide 1: (Atlas Map)

It is the physical map of India from a school atlas. The Ganges Basin, the Aravalli-Marwar zone and the Indus basin are clearly defined. Geophysically,

* Further attempts have been made to update even this map further. Some of these are brought out in the current lecture.

the Ganga Basin consists of Siwalik/Alluvium wedge increasing in thickness from zero in the south upto about 4 km. near the foothills. It is underlain by a highly eroded Vindhyan base. It is a relatively simple structure.

Slide 2: (Kota – Nagaur DSS Profile)

A deep seismic sounding section from Kota upto Nagaur across the Aravalli Range brings out the Great Boundary Thrust of Rajasthan followed by a big uplifted block of the Aravalli range. Its western edge is faulted into the Marwar block. In the latter block the crust thins westwards towards Nagaur.

Slide 3: (Physical - 4)

West of Nagaur lies a crustal dome, much of it occupied by the Indian desert. Its western boundary is marked by the Thar Rift. It is a major fault whose trace is clearly seen in the physical map. The entire area west of the Thar Rift is the Indus basin.

Slide 4: (Aeromagnetic)

The junction of the Nagaur dome with the Indus Basin is dramatically brought out by the aeromagnetic map of a part of the area.

Slide 5: (Physical – 2)

The Indus basin is bounded in the NW by a subsurface basement uplift, which is the Sarghoda Ridge. Its trace along its axis is marked by the Malani exposures near Sarghoda and the Kirana Hills.

West of the Thar Rift the crust of the Indus basin thins out leading to an uplift in the lower crust, increase in average crustal density and corresponding surface depression due to isostasy. The depression is then filled by sediments, resulting in a vast Mesozoic basin. The Indus basin is divided into two parts separated by the Jaisalmer – Mari – Suleiman arch (Slide 6) All the Punjab rivers are included in the eastern part. A deep well drilled near Multan shows that the sedimentary column there is practically identical with that in the Potwar plateau. The entire section from the paleozoic to the tertiary is present.

Slide 7:

This is a section from Jaisalmer across the western part of the Indus basin upto the ophiolite outcrops near Bela in the Kirthar Range region. It originates from the work of oil companies that have worked in Pakistan in the past. One can see a significant crustal thinning below the sedimentary cover. The Indian crust terminates at the Indus river. The limiting line can be followed along the Indus river upto its mouth and then further upto the shelf

edge. From there it continues along the shelf edge upto Kanya Kumari. West of the river in the Kirthar area the mantle rises and the sediments rest directly on the mantle. It has been termed the Indus fossil rift.

Slide 8 :

The dominant feature in the western basin is the Jacobabad – Khairpur High. The Indus fossil rift lies to the west of this high. The southward extension of the fossil rift upto Karachi and the shelf edge is shown in the slide.

A basement contour map in the deep sea beyond the shelf shows the southwest extension of the rift extending upto approximately 20 degrees latitude. At 19 degree latitude magnetic stripe 28 is observed. This corresponds to a Paleocene sea bottom, thus limiting the mesozoics upto 20degrees or so. The rift is bounded on the north and northwest by the Owen Fracture Zone.

The E – W Kutch Rift has been marked green and is contained between the Nagarparkar line in the north and northern Saurashtra coast in the south. The rift is confined to the Indian crust.

The Saurashtra peninsula (marked red) extends westward beyond the shelf edge upto longitude 64degrees. The extension is a continental slab under about 1500 metres of water. It is separated from from the main peninsula by a narrow rift which we will call the mid – Saurashtra rift.

The Laxmi Basin lies south of 20 degrees latitude and separates the Laxmi ridge from the west coast. This is another rift, but is of tertiary age. The Mesozoic and tertiary rifts are separated by a western extension of the Central Indian Tectonic Zone upto the Owen Fracture.

The above description of the huge Mesozoic basin riddled with rifts and block faults has obviously a different tectonic history from that of the Ganga basin, which is a much simpler structure. While the Ganga basin is a zone of compression, the Indus basin is in a zone of extension. The formation of the mesozoic basin has been ascribed to to the separation of India from Gondwanaland. Upwelling of the mantle between India and South Africa led to tension in the crust leading to stretching consequent thinning. The crust sank in response to the thinning in accordance with the principle of isostasy. The sinking crust formed a basin in which sediments were deposited - the timing was essentially Mesozoic. The fractured crust is the evidence of the extreme stretching.



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Slide 1

Deep Seismic Section Across the Aravalli

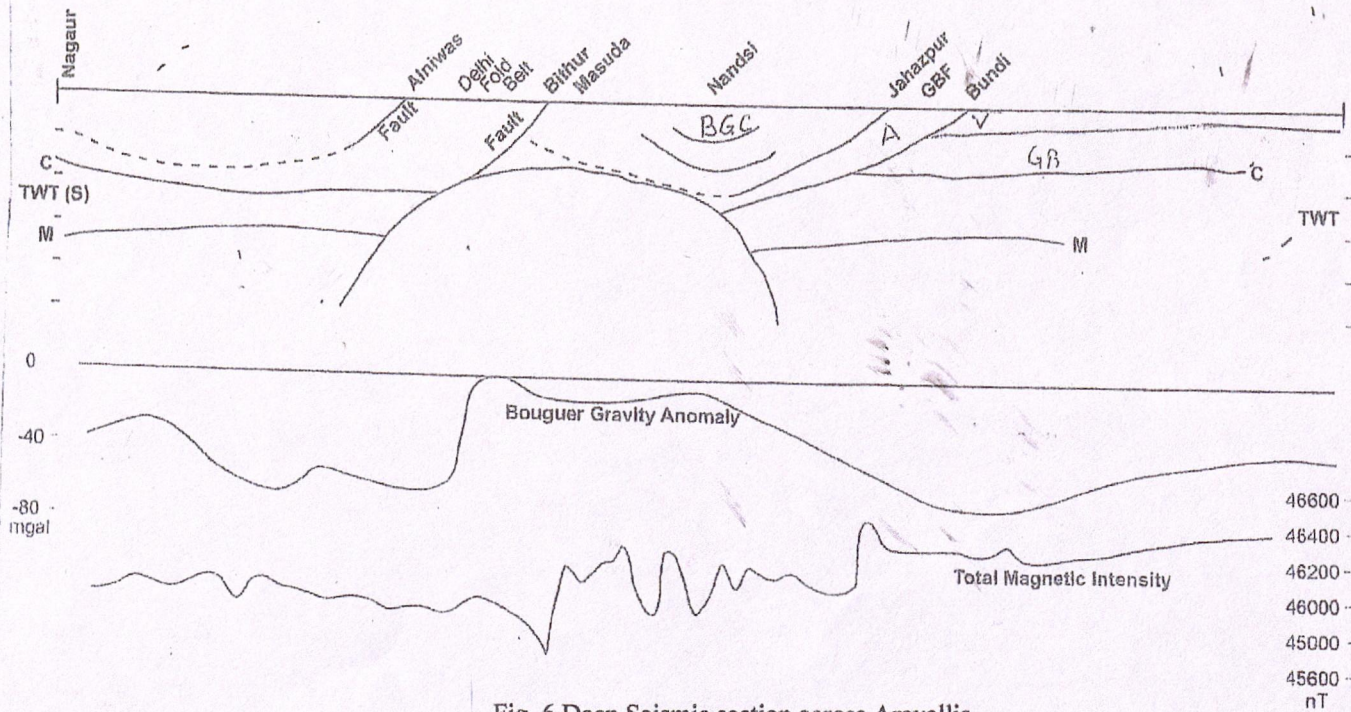


Fig. 6 Deep Seismic section across Aravallis

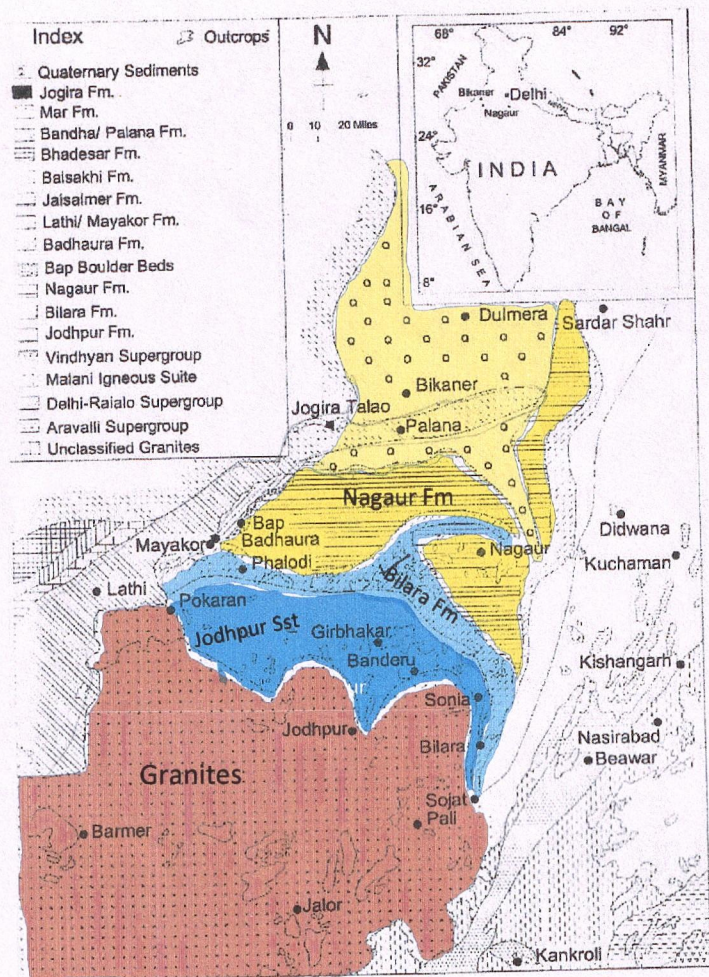


Fig.2. Geological map of West-Central Rajasthan (modified after Shrivastava, 1971; Pareek, 1984).

slide 3

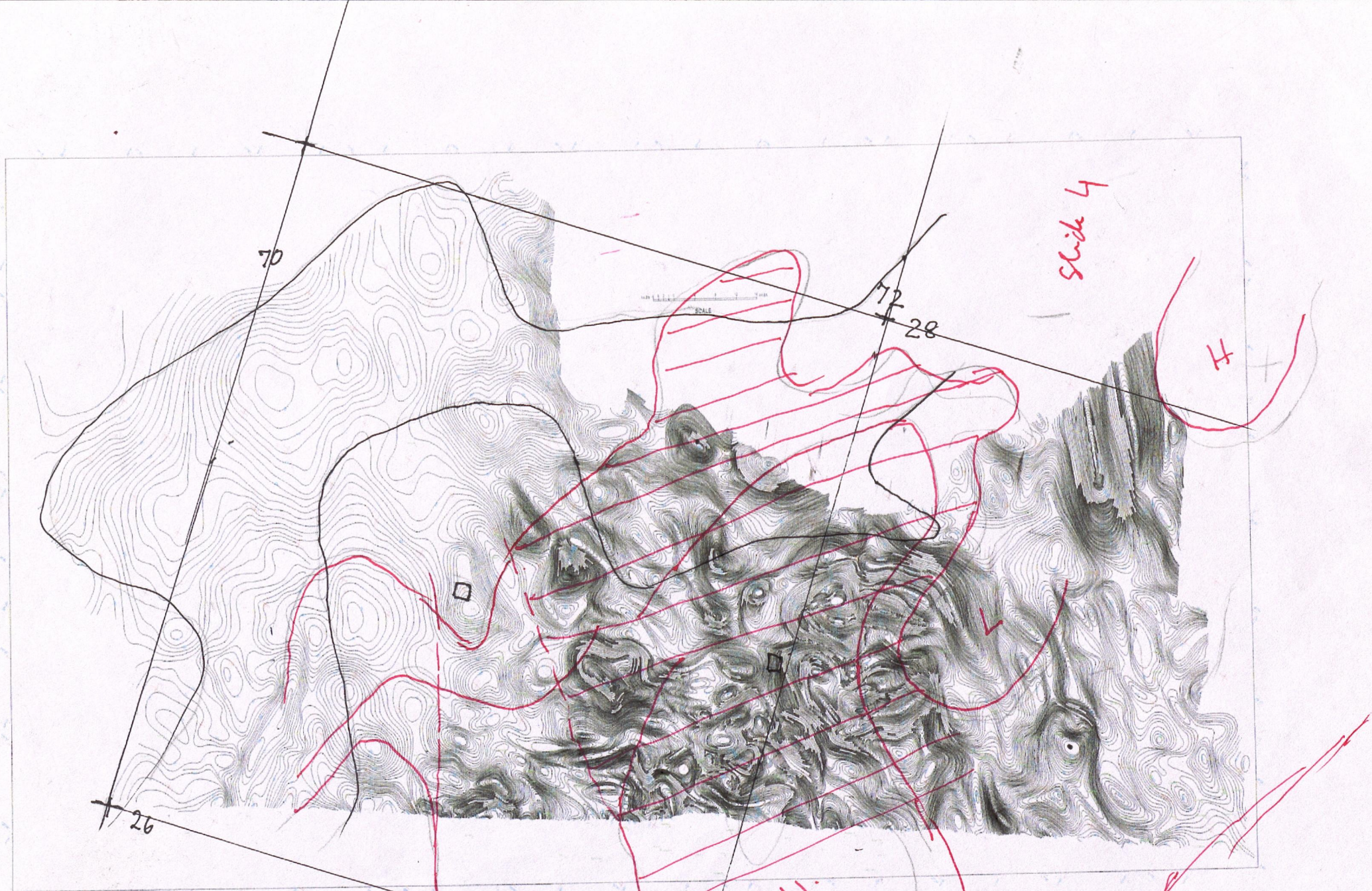
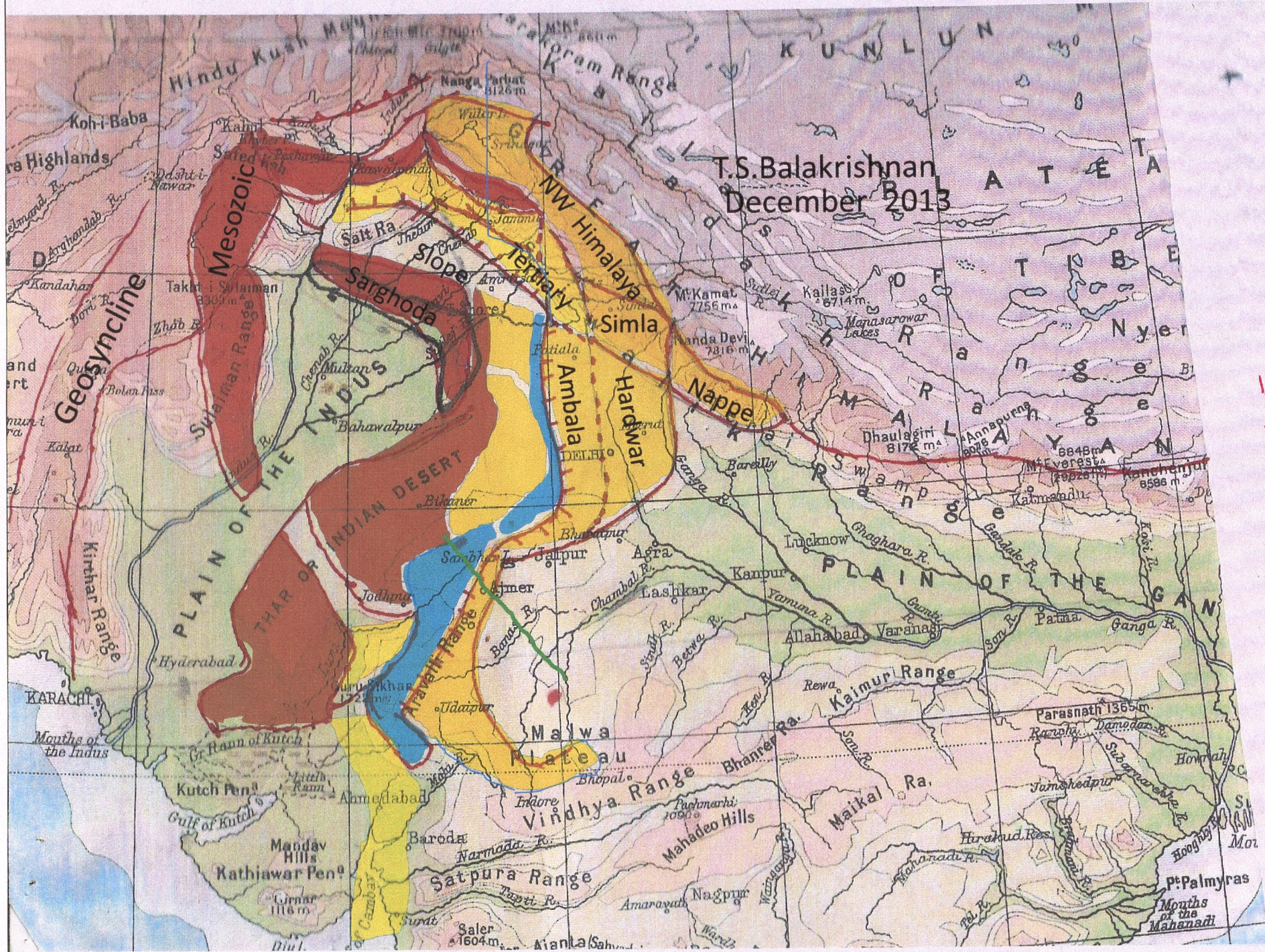
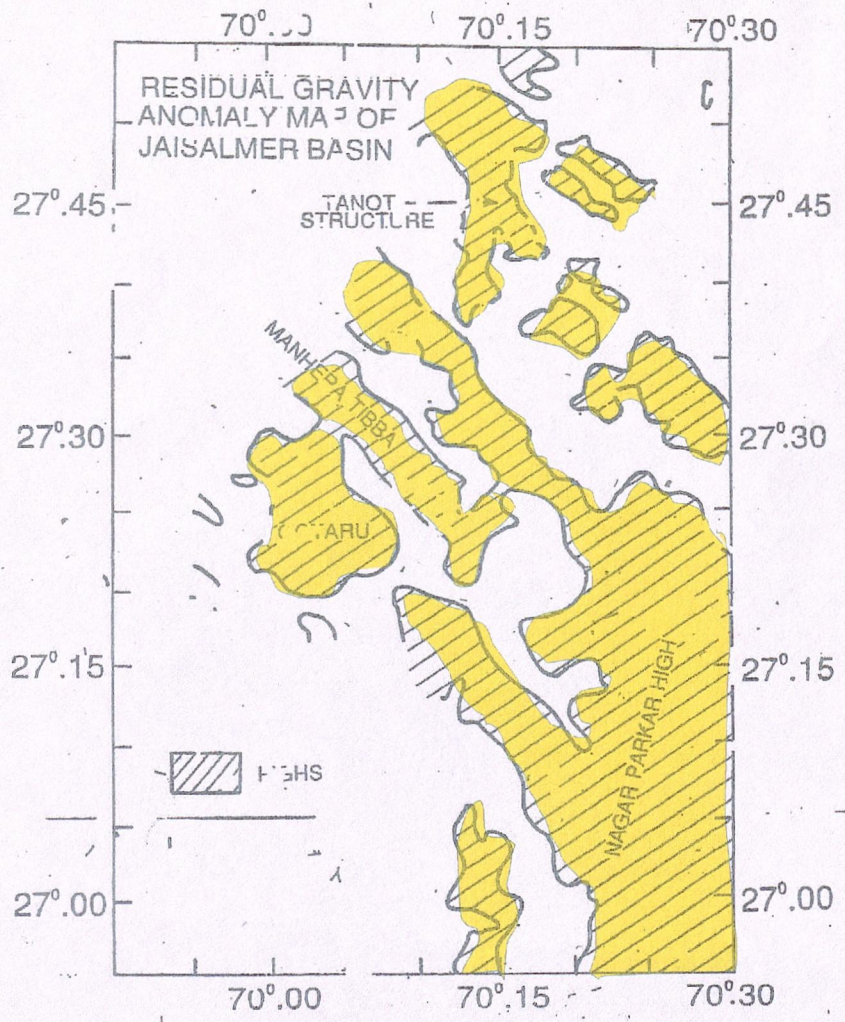


Fig 10. Magnetic anomalies in Pokaran - Jaisalmer area

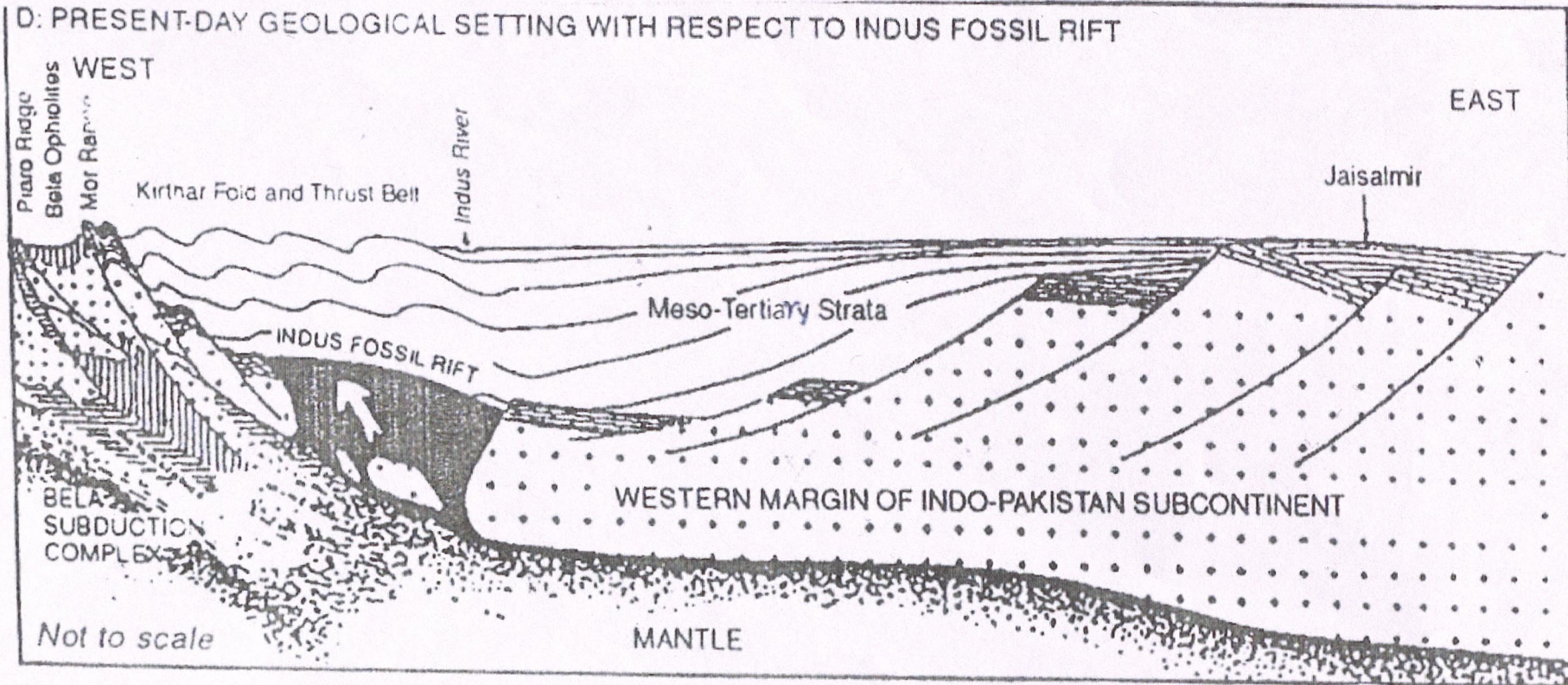


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Slide 5



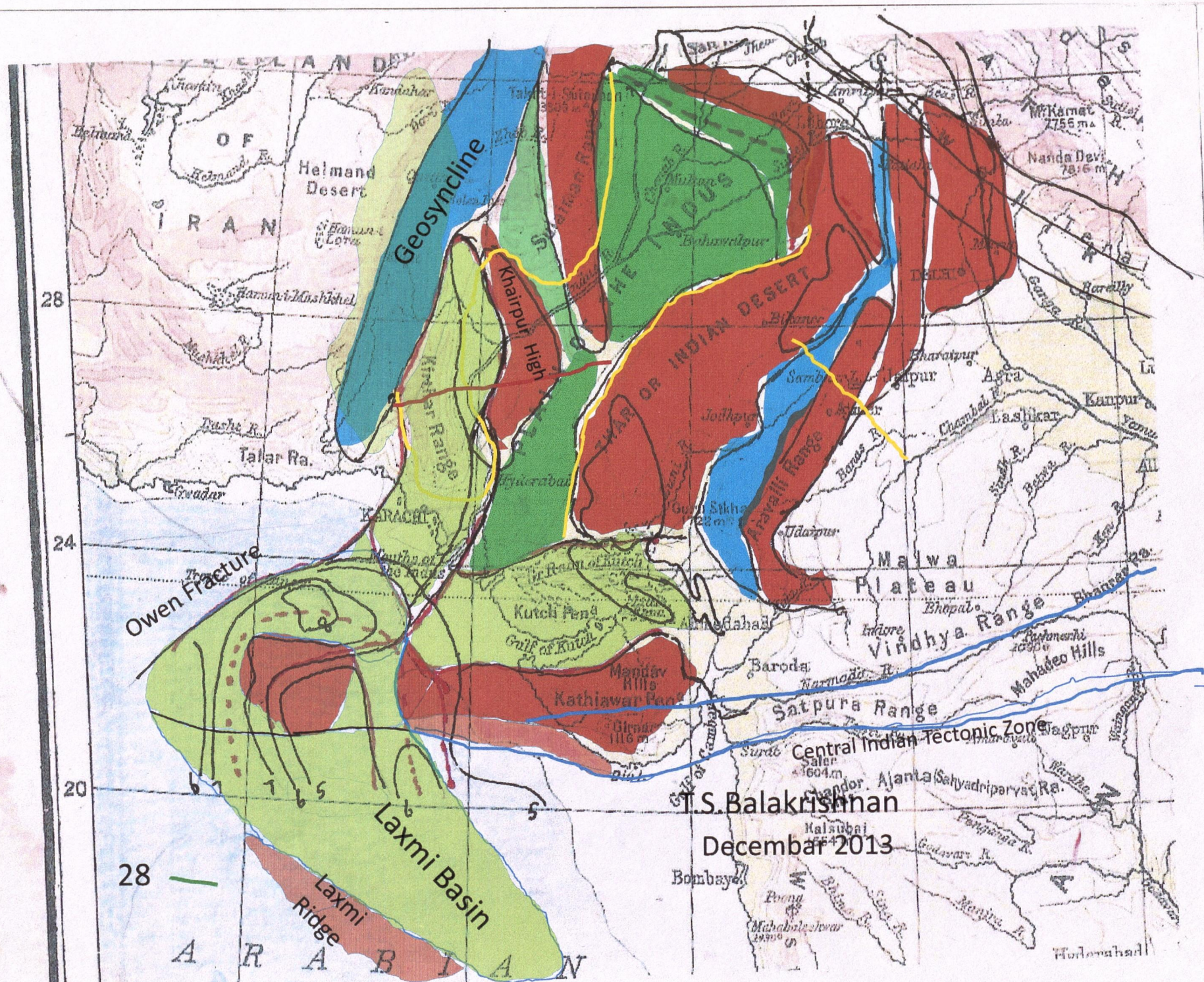
Slide 7



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Fig.52 Interpreted section from Jaisalmer to western end of plate

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Slide 8