

# The Geo-Saurus & Geo-Monster: a new approach to remembering the geological and geomorphic features of Pakistan!

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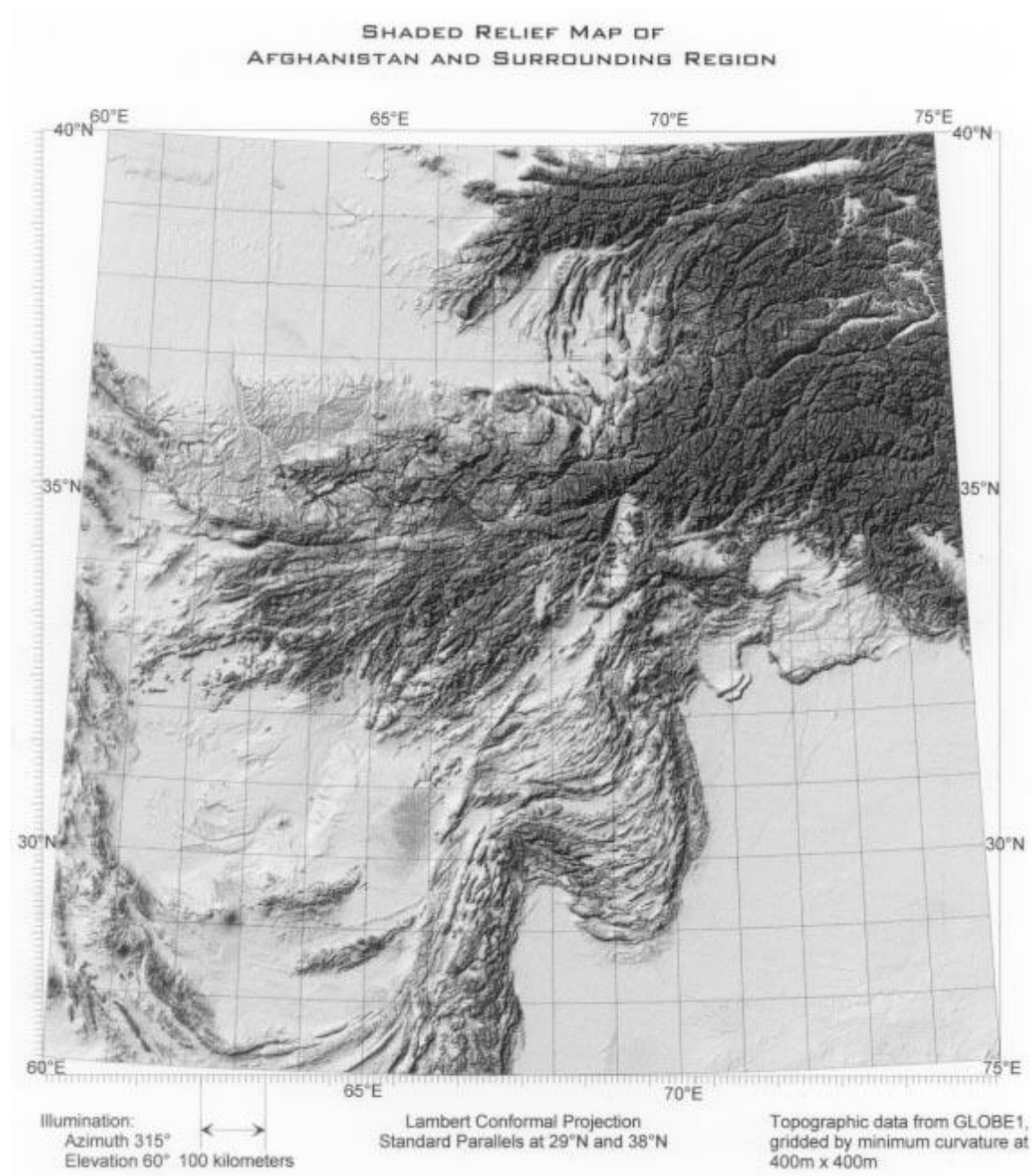
In the recent past the geological and geomorphological features of Pakistan have been extensively mapped and photographed, in the field and with the help of planes and satellites, giving us an accurate picture of the landform. When carefully scrutinized, these aerial photographs and the resulting relief maps reveal, one or two, interesting 'creature like features'. At least that is what I have observed and I thought it would be interesting if I could delineate 'the creature(s)' and share it with others, in particular with the first year degree course students of geology. The idea behind these figures is to help students familiarize themselves with the main geological features who can then look at it in the regional context, that is, with respect to the geology of the neighbouring countries in order to find and complete the missing parts.

For the sake of simplicity I have avoided the incorporation of certain structural details. In fact my emphasis is on the form of these fictitious animals, anything outside of the form has therefore been removed. I hope students of geology of Pakistan as well as the general public will find it helpful - if not meaningful - to remember the location of geological features and certain mountain ranges.

Please also note I have based my modified figure on D. Bannert's map (1995).

In order to appreciate the creature(s) that I have delineated, I would invite you first to have a good look at the central part of Relief Map of Afghanistan and the Surrounding Region (Fig. 1), in particular the region south of latitude  $34^{\circ}$  and east of longitude  $66^{\circ}$ , the head being between  $70^{\circ}$  and  $72^{\circ}$ . Once you have done this, and then compare Fig. 2 with the relief map (Fig. 1). Now if we look carefully at Figs. 1 & 3, we will notice that by moving further east, up to Jhelum River near  $E74^{\circ}$ , the head of Fig. 2 amalgamates into a new head-like shape that resembles the head of a horse. Basically Fig. 3 contains two heads in one!

I am sure you have also managed to delineate the same animal outline that, below in Fig. 2, I have referred to as **Geo-monster**. Its head looks a bit like a big wild cat with its mouth wide open! The figure does not cover the whole of the geological map of Pakistan - only the northern most parts (the Northern Montane Area) are missing. However, I have added Fig. 5 (Raza & Bender, 1995) to help readers visualize the locations of basins and major structural features of Pakistan; it is worth mentioning here that Fig. 5 only shows the subdivisions of the Indus basin.

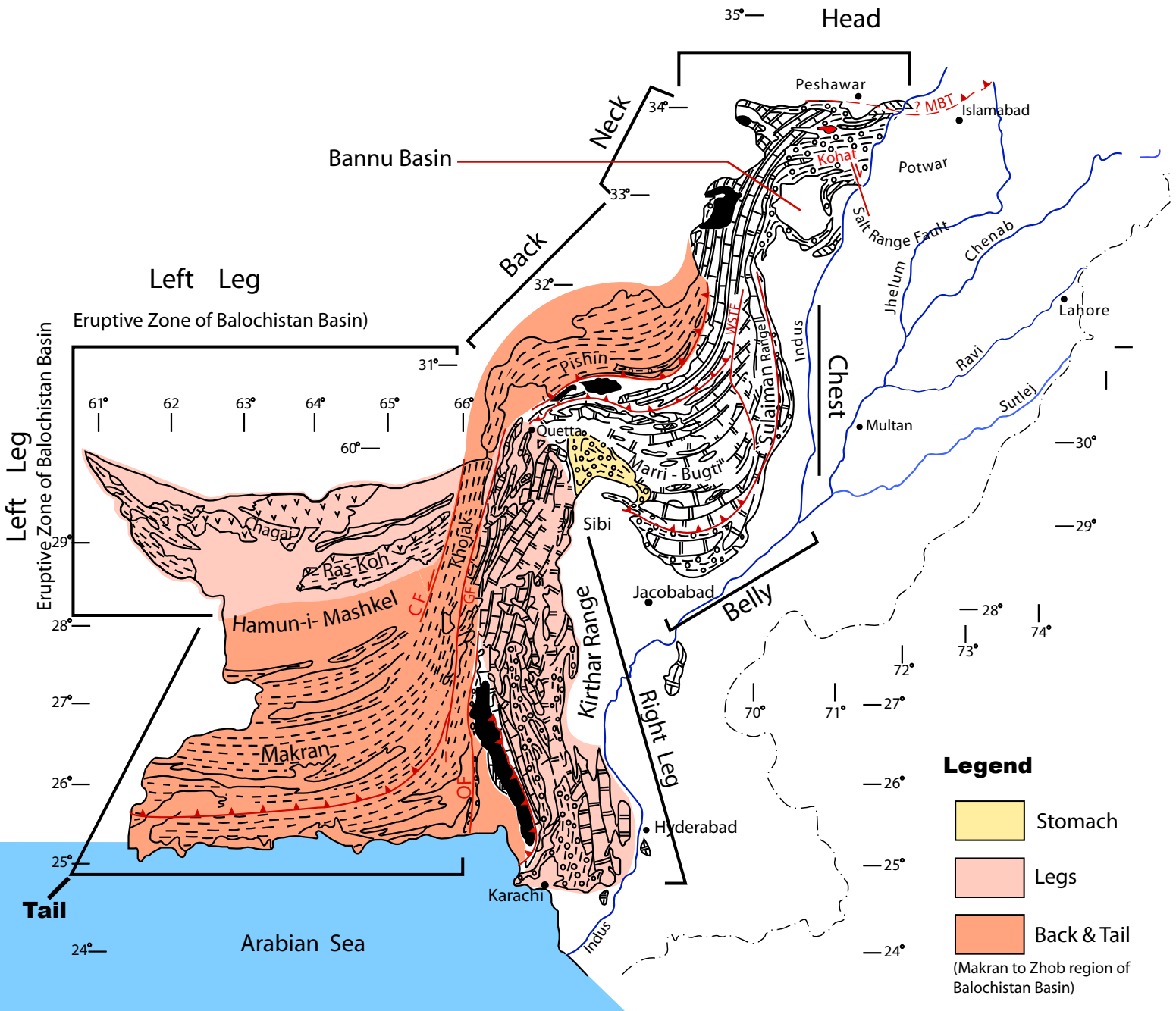
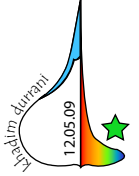


**Figure 1:** Relief map of Afghanistan and surrounding region (Courtesy of Lee R. Rice., Data Technology Services (USA)).

Now please once again look carefully at the Figs. 2 & 3 and then read the corresponding description below. In Fig. 3 additional outlines were drawn in the upper part and the coloured back of the animal was also extended beyond the Pakistani border, into Afghanistan, in order to enhance the animal-form of the figure. Further information explaining geological features has been provided at the end (in the *notes*).

# Body Parts of Geo-Monster

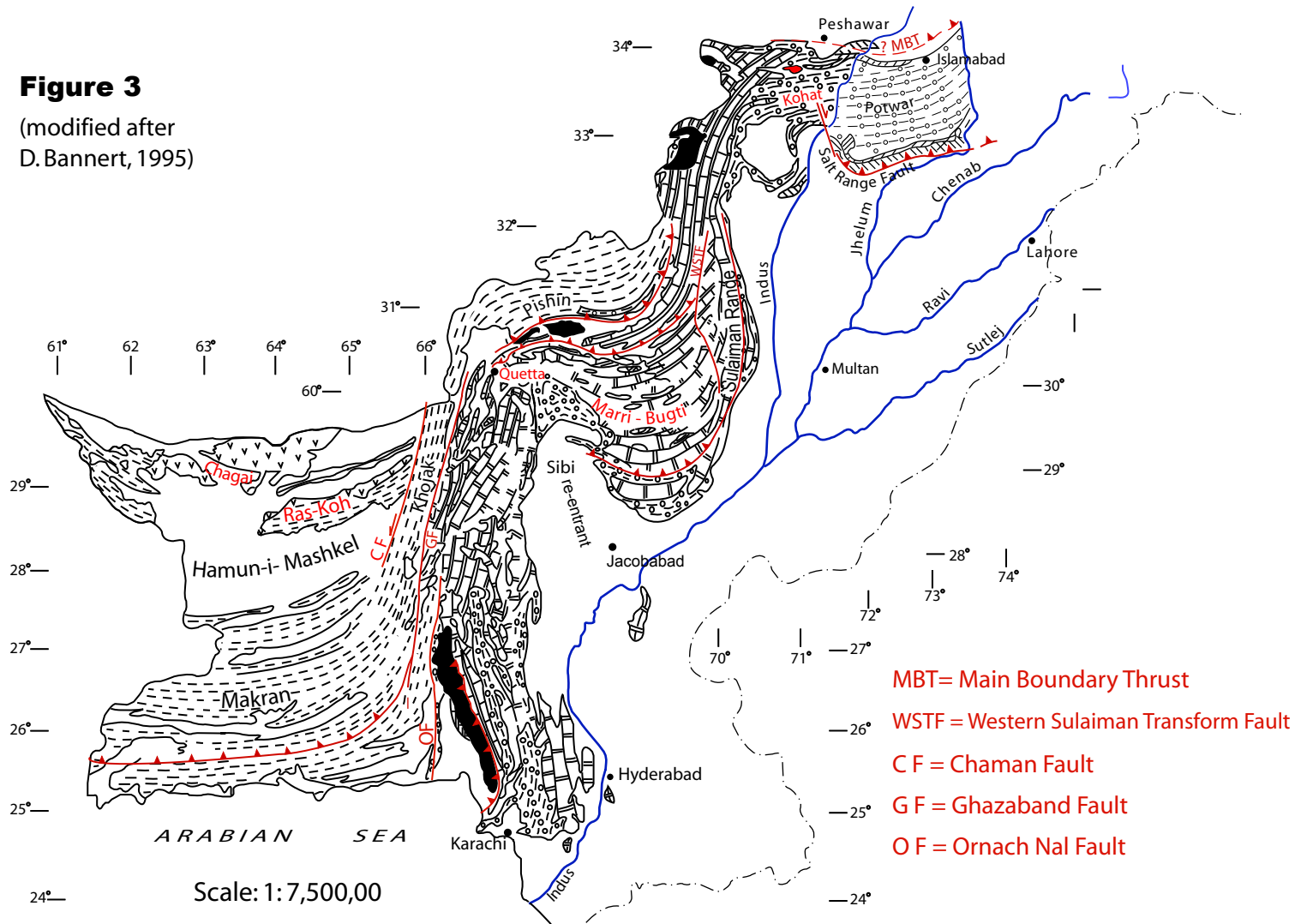
## Figure 2



# The Geo-saurus

**Figure 3**

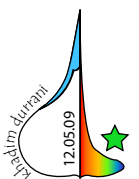
(modified after  
D. Bannert, 1995)



MBT= Main Boundary Thrust  
WSTF = Western Sulaiman Transform Fault  
CF = Chaman Fault  
GF = Ghazaband Fault  
OF = Ornach Nal Fault

**Legend**

- Quaternary, mostly unfolded & unconsolidated clastic sediments
- Tertiary - Recent Molasse, folded, including shallow water limestone
- Cretaceous - Tertiary Flysch, including Mirjawa, Raskoh, Makran, Khojak and Pishin segments
- Cretaceous - Recent volcanics and associated volcanoclastic sediments
- Late Mesozoic - Early Tertiary Ophiolites of the Bela-Waziristan Ophiolite Zone
- Tertiary marine shelf sediments
- Mesozoic marine sediments of the Western Fold Belt
- Mesozoic - Tertiary sediments and metamorphic in Hazara and northern Pakistan
- Proterozoic - Paleozoic sediments, partly metamorphic in Hazara and northern Pakistan
- Regional strike-slip faults
- Thrust faults



## **Geo-Saurus: description of the body parts (Figs. 2 & 4)**

**The head:** it can be seen clearly in the above figures that the **Main Boundary Thrust (MBT)<sup>i</sup>** is running east-west over the head while the **Salt Range Fault (SRF)** defines the lower jaw of the animal. The Indus River divides the head into two well known geographic areas: a) the **Potwar Plateau** to the right and b) **Kohat** to the left. Islamabad can be remembered as the nostril (in Potwar) while Peshawar being closer to the eyebrow of the animal - the area around Peshawar is also known as the '**Peshawar Basin**'. The head itself constitutes part of the **Upper Indus Basin<sup>ii</sup>** (i.e., Kohat - Potwar Province; Shah, 1977).

**The neck:** the black spot at the back of the neck corresponds to the **Waziristan Ophiolites**.

**The chest:** the thorax part represents the **Sulaiman Range<sup>iii</sup>**, east of which the Indus River runs almost north-south along its (chest's) entire length, before being joined in by other four rivers near latitude 29°.

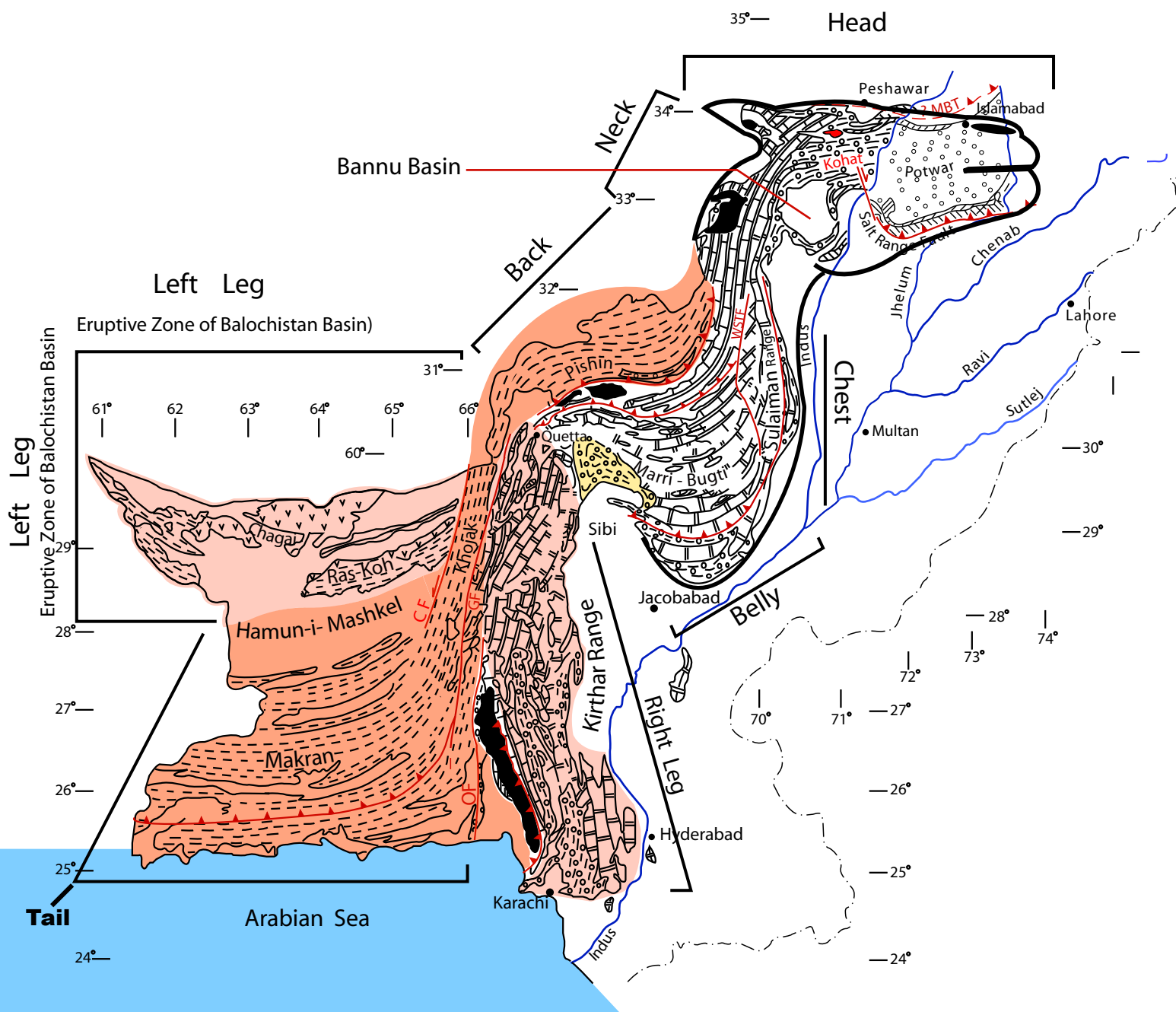
**The belly:** the lower reaches of Sulaiman Range, turning south-westwards, lead us to the **Marri-Bugti hills** which in the figure looks like a huge bulging belly (also known as the Sulaiman lobe); natural gas is found here towards the southernmost tip at Sui (the belly button). Please remember the connection between the stomach/belly and the gasses. Now if we follow the outer reaches of the belly and move west and then continue up north-westwards, we get to a triangular shaped area (**the stomach**) in the figure which is the region of **Urak - Sibi Trough** (near **Quetta syntaxis**), adjacent to which, in the lower southern reaches, is the **Sibi re-entrant**. The Urak-Sibi Trough is between the **Sulaiman lobe** (the belly) and **Kirthar Range** (the right leg). For subdivisions of basins and their locations, please refer to the Fig. 5 and notes below.

**The hands:** unfortunately it has small hands which cover its aching tummy!

**The back:** **Makran-Khojak-Pishin Flysch Zone<sup>iv</sup>** can be remembered as to be lying on the back; Makran being its tail (i.e., Makran Zhob region of Balochistan Basin) while **Muslimbagh Ophiolites** can be remembered as the lower back of the Geo-saurus. Also to remember is the location of **Pishin/Katawaz Basin<sup>v</sup>** which is between Muslimbagh ophiolites (the lower back) and the Waziristan Ophiolites (the back of the neck). **The Bela-Muslimbagh-Waziristan ophiolite zones** also mark the **north-western boundary of the Indian Plate** and extend generally south and southwest from northern Pakistan to the Arabian Sea - **the Bela ophiolite zone** being the southernmost exposure northwest of Karachi.

# Body Parts of Geo-saurus

## Figure 4

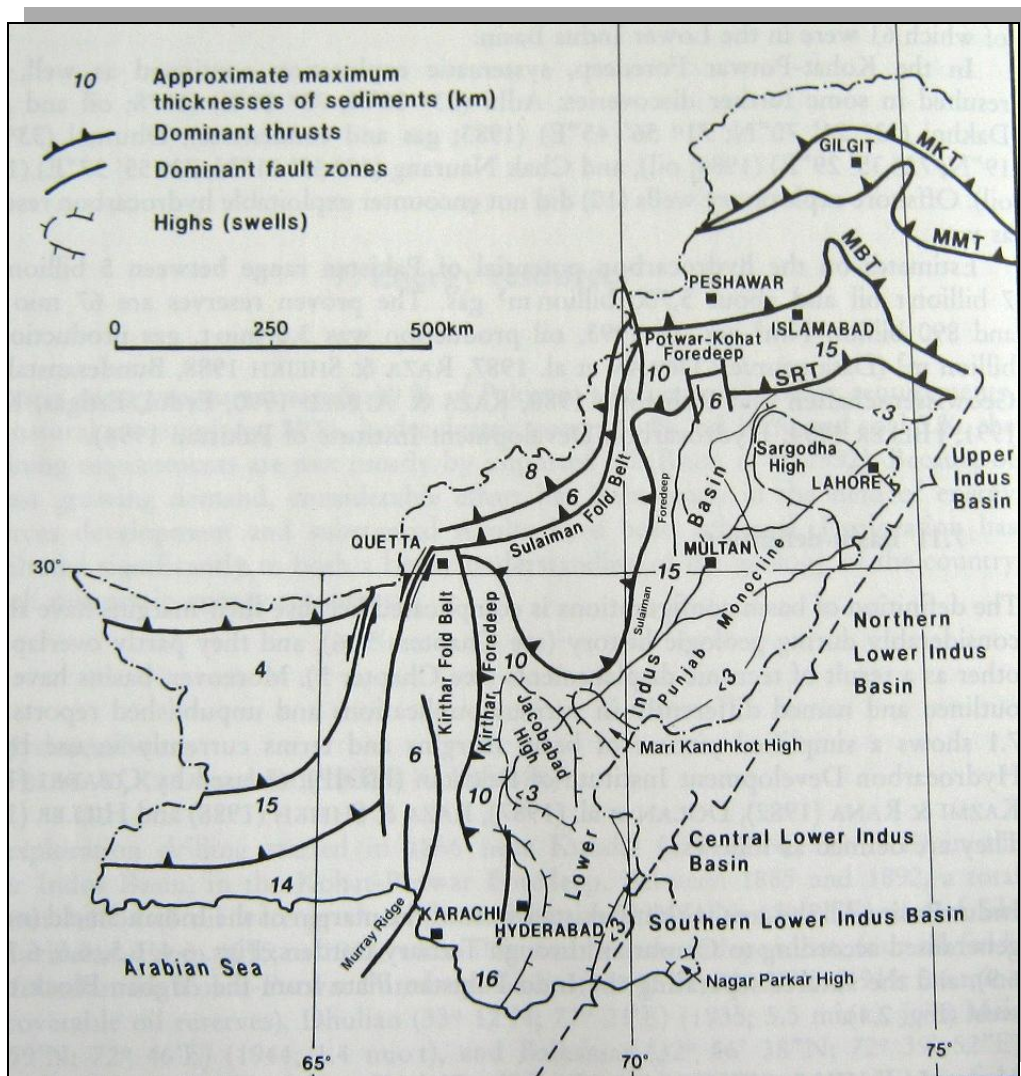


### Legend

- Stomach (Urak - Sibi Trough)
- Legs (Right Leg covers Kirthar Range and under the Left Leg comes 'Eruptive Zone of Balochistan Basin')
- Back & Tail (Makran to Zhob region of Balochistan Basin)

Legs: from Quetta southwards down to Karachi runs the Kirthar Range<sup>vi</sup> which looks like the right leg. (The area east of Kirthar Range and west of **Jacobabad High** is also known as the 'Kirthar Province of Lower Indus Basin'). While **the Ras-Koh and Chaghai volcanics** and volcanoclastic sediments can be considered as being its left leg (i.e., **Eruptive Zone of Balochistan Basin<sup>vii</sup>**).

The Figs. 2 & 4 also give the impression as if the animal has just come out of the sea and is on the run!



**Figure 5.** Map showing simplified basin margins in Pakistan and major thrusts and fault zones (Courtesy of Raza & Bender, 1995). For practical reasons the northern most areas beyond MBT, present in this map, are not included in the Figs. 2 & 3.

**The Rivers:** The five major rivers of Pakistan from west to east are: Indus, Jhelum, Chenab, Ravi and Sutlej; they ultimately join Indus River near latitude 29°. They can be remembered with reference to the Geosaurus figure.

**Geo-Poli-ticking!** Lastly, the regions of Waziristan, Swat in the northwest and Sui in the Marri-Bugti areas of the Sulaiman lobe represent the hotspots of the regional 'Geo-Politics'. In fact in these regions 'politics' is shaped by the local geology of the area, e.g., takeover of emerald mines in the Malakand region by those who oppose development/modernity and, the political unrest in the Sui region.

## References

**Bender, F. K & Raza, H. A., (Editors), 1995.** Geology of Pakistan. *Publisher:* Gerbruder Borntraeger, Berlin. Germany. Pages: 414.

**Iqbal, M., (June 2004).** Integration of Satellite Data and Field Observations in Pishin Basin, Balochistan, Pakistan Journal of Hydrocarbon Research, Vol.14, p.1-17.

**Meigs, J., Burbank, D. W., & Beck R. A., 1995.** Middle-late Miocene (> 10 Ma) formation of the Main Boundary thrust in the western Himalaya. *Geology; May 1995; v. 23; no. 5; p. 423-426.*

**Shah, I., (Editor), 1977.** Stratigraphy of Pakistan, volume 12, Geological Survey of Pakistan, Quetta, Pakistan.

For further reading please consult:

**Farah, A. & DeJong, K. A. (Editors), 1979.** Geodynamics of Pakistan. *Publisher:* Geological Survey of Pakistan, Quetta. Pages: 361.

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*Notes:*

<sup>i</sup> **The main Boundary Thrust (MBT)** has been defined as the southernmost thrust that places metasedimentary rocks of the lesser Himalaya over unmetamorphosed clastic rocks of the Himalayan foredeep (Meigs *et al.*, 1995). The MBT also marks the physiographic south border of the Himalayas in Pakistan.

<sup>ii</sup> **The Indus Basin** (Fig. 5) is very vast; it is located west of the Indian Shield. Starting from the Main Boundary Thrust (MBT) in the north, it extends for over 1,200 km to the offshore area south of Karachi, east of the Murray Ridge and to the west it is confined by the West Pakistan Foldbelt. Based upon differences in structure, sedimentary facies development, and chronostratigraphic sequences, the Indus Basin has been further subdivided into four categories: **1) Upper Indus Basin** - area between MBT in the north and Sargodha High in the south,

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comprising the Kohat-Potwar Foredeep including the Bannu Depression; **2) Northern Lower Indus Basin** - between Sargodha High and the Mari Kandkot High; **3) Central Lower Indus Basin**- south of the Mari Khandkot High to the southwestern margin of the Jacobabad High, and **4) Southern Lower Indus Basin** - area east of the Murray Ridge and west of the Naga High.

**iii The Sulaiman Range** is part of the active fold-and-thrust system along the western margin of Indo-Pakistani plate. The 250 km wide Sulaiman lobe is bounded to the northwest and north by the Zhob Thrust and Katawaz flysch basin, to the northeast, east and southeast by the Indus plain constituting the Sulaiman foredeep, and to the southwest and west by the Urak-Sibi Trough (Sibi Re-entrant).

**iv The Makran-Khojak-Pishin Flysch Zone** constitutes part of the continental margin of the Afghan Block in the southern part of the Eurasian Plate. The sediments in this zone are mainly of geosynclinal flysch type which locally grade into orogenic molasse sediments. Based on different tectonic styles, this zone can be divided into three segments: the Makran-, Khojak-, and Pishin segments. In Afghanistan the Pishin segment is known as 'Katawaz'.

**v The Pishin (or Katwaz) Basin** is located on the western corner of Indo-Pakistan Plate. It is bounded in the east by ophiolite suites and Zhob Valley Thrust (ZVT) whereas sinistral Chaman Fault occurs in its west. In the north it extends to the Main Boundary Thrust (MBT) and in the southwest becomes narrow and merges to Makran area. It is shaped and compressed generally in east west direction, stretched from north to south, shortened and inverted during Late Tertiary collision between Indian Plate and Afghan Block (Iqbal, 2004).

**vi The Kirthar Range** extends southward for about 190 miles (300 km) from the Mūla River in east-central Balochistān to Cape Muāri (Monze) west of Karāchi on the [Arabian Sea](#). The range forms the boundary between the Lower Indus Plain (east) and southern Balochistān (west). It consists of a series of parallel, rock hill ridges rising from 4,000 feet (1,200 m) in the south to nearly 8,000 feet (2,500 m) in the north (<http://www.britannica.com/EBchecked/topic/319321/Kirthar-Range>)

**vii The Balochistan Basin:** all that area within Pakistan to the west of the suture zones is known as the Balochistan Basin (*Note: the way Pishin/Katawaz basin has been defined shows that it coincides or is synonymous with the definition of Balochistan Basin that deals with the Makran - Zhob part*). **The Chaghai and Ras Koh area** (Left Leg in Fig. 2 & 4 above) is known as the '**Eruptive Zone of Balochistan Basin**' (Shah, 1977).

**Last word:** In the above article inconsistencies such as basin names and their outlines were unavoidable as various publications and reports use different basin outlines and names and that is because due to the ever changing nature of the Earth sciences and ongoing research our knowledge about the geology of the region is being continuously updated. For example in Shah (1977) we come across different basin nomenclature while Raza and Bender (1995) redefine and base their basin names on work carried out by previous researchers. Another good example is the name 'Pishin Basin' (Raza & Bender, 1995; Iqbal, 2004) which is in fact northern part of the Balochistan Basin of Shah (1977) and earlier workers. The name Katawaz basin has also been used interchangeably with the 'Pishin Basin' – because Pishin/Katawaz basin in Pakistan represents the Pishin Segment of the Makran-Khojak-Pishin Flysch Zone, which in Afghanistan is known as Katawaz.