

IDC-6, Varanasi
Tentative plan for Pre-Conference Field Trip 2

DYKE SWARMS OF THE DECCAN TRAPS

January 30 – February 3, 2010

Trip leaders

- Nitin R. Karmalkar, University of Pune (nrkarmal@unipune.ernet.in)
- Hetu C. Sheth, Indian Institute of Technology Bombay (hesheth@iitb.ac.in)
- Raymond A. Duraiswami, University of Pune (raymond_d@rediffmail.com)

Summary: This field trip will cover dykes of all the three major dyke swarms in the Deccan province. It will show not only the abundant tholeiitic (basalt and dolerite) dykes, but also alkaline dykes and associated intrusions. The field trip will also familiarize the participants with the features and architectures of both “compound” and “simple” flows of the Deccan, as well as the Deccan’s spectacular landscapes.

Relevant literature, including maps and a field trip guide book will be compiled in due course and distributed to the participants. Participants will also be able to collect rock samples from the dykes at most locations. A few hammers and chisels may be available with the field trip leaders; it is recommended that sampling enthusiasts carry their own as well.

The weather in February in these areas of the Deccan is expected to be cool and pleasant, and cold at night. Daytime temperatures will be 15-20 °C and nighttime temperatures can be 5-10 °C. Participants should carry warm clothing, camera, any medication they may be using, medical insurance, good field shoes, etc. In general there will not be much walking to do, and whatever walking is anticipated will not involve climbing. In the field the participants will be careful about their safety, for example, not venture too close to the edges of escarpments, and watch out for snakes or poisonous insects. These exist, though are rarely encountered.

Below is a tentative plan of the trip, along with field photos that cover the whole proposed area, and some literature references and a key map at the end. Costs etc. are mentioned separately on the IDC-6 website.

All photos © Hetu Sheth

Day 0 (Jan. 29)

Participants arrive Pune on their own by night. Distribution of field trip materials. Night stay at Pune (U. Pune/IUCAA Guest House).

Pune is located some 150 km (~4 hours by car) ESE of Mumbai, the latter being India’s bustling and exploding metropolis with 20 million people and a major transport hub. Whereas Mumbai is at sea level, Pune is located on the Deccan plateau at an elevation of 900 m. In coming from Mumbai one thus climbs up the Western Ghats escarpment.

Day 1 (Jan. 30)

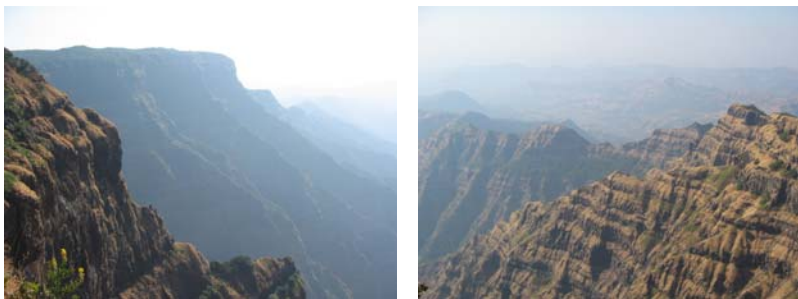
Begin 8.30 after breakfast. Examine Deccan compound flows and dykes (part of the WESTERN GHATS DYKE SWARM) between Pune and Lonavala (forenoon). Lunch as convenient.

Turn south towards Satara (bypass Pune city). Arrive Wai and climb up the ghat section road to Panchgani. Arrive Panchgani early afternoon (13.00 hrs.) Walk the extensive Panchgani plateau and examine the well-developed ferricrete (“laterite”) cap over the Deccan basalts.



Typical Deccan scenery near Panchgani (left), and one of the many ferricrete-capped mesas (right)

Leave Panchgani at ~15.00 hrs. for Mahabaleshwar (a popular hill station), 20 km to the west. Before entering Mahabaleshwar town, turn north for the Arthur’s Seat viewpoint (20 km). Enjoy breathtaking views of the >1-km-thick Deccan lava sequence before sunset. Depart 18.00 hrs. for Mahabaleshwar and enter hotel. An hour or so free for shopping/sightseeing. Dinner and night stay at Mahabaleshwar.



Views towards the Konkan Plain from the edge of the Western Ghats, at Arthur’s Seat (1,347 m)

Day 2 (Jan. 31)

After early breakfast, depart Mahabaleshwar 8.30 hrs. and descend the Ambenali Ghat, to Poladpur on the Konkan Plain. On the way, examine the simple flows and red boles. Turn north towards Murud via Mahad. Briefly see the extensive columnar-jointed simple flow (Poladpur Fm.) around Mahad and the flow lobes of the compound flow (Bushe Fm.) on the Savitri River bed.



The Western Ghats escarpment from the Mahabaleshwar-Poladpur ghat road (left), and an extensive, columnar jointed “simple” basalt flow near Mahad, on the Konkan Plain.

Continue northward to Murud, and arrive at 12.00 hrs. See compound flows of basalt, wave-cut bench and tephriphonolite/nepheline syenite, lamprophyre and dolerite dykes (part of the

KONKAN/COASTAL DYKE SWARM) at Murud. Turn south to Janjira, a few kilometres, and see the nephelinite plug. Lunch at Janjira or Murud.



Lamprophyre dyke intruding compound flows of basalt as exposed on the wave-cut bench, Murud. Pen for scale in the second photo is 9 cm for scale.

Leave Murud at 14.00 hrs. for Borlai-Korlai to the north. Examine splendid tholeiitic dykes and dykelets (again, KONKAN DYKE SWARM), and a microdiorite plug, at Borlai-Korlai.



Basalt dykes and dykelets intruding compound flows of basalt as exposed on the intertidal zone at Borlai-Korlai.



A microdiorite plug at Borlai-Korlai with hill of basalt flows beyond (left), and a dolerite dyke north of Borlai-Korlai.

Leave Borlai-Korlai at 16.00 hrs. for Alibag, and see another good dolerite dyke, a few kilometres north of it, emplaced in the flow-top breccia of a basalt flow. Arrive Alibag and enjoy sunset at beach. Take hotel. Dinner and night stay at Alibag.

Day 3 (Feb. 1)

Leave Alibag 8.30 hrs. after breakfast and begin a long journey to the north. Reach Kalyan via Panvel, and get on the N. H. 3 for Dhule (~7 hrs. from Kalyan via Kasara-Igatpuri-Nasik-Chandwad-Malegaon). One climbs the Western Ghats escarpment again in going from Kasara to Igatpuri. See

some spectacular Deccan landscapes over thick compound flow sequences along this route. Lunch on the way, possibly at Nasik. Time permitting see the Pandav Leni Buddhist caves. Reach Dhule at night and take hotel. Dinner and night stay at Dhule.



Typical scenery in the Deccan compound flows near Chandwad, north of Nasik, on the N. H. 3. The cliffs are some 300 m high.

Day 4 (Feb. 2)

Should be an exciting day, examining many spectacular tholeiitic dykes of the TAPI DYKE SWARM. May have to take packed lunch along. Begin 8.30 after breakfast. Visit the longest known dyke in the Deccan (79 km) in road cut 3 km N of Dhule town. Turn west towards Sakri, and then NW to Nandurbar. See many E-W dykes in this area, some several tens of kilometres long.



Basalt and dolerite dykes, some tens of kilometres long, in the Sakri-Nandurbar area

From Nandurbar, reach Shahada, and drive north from Shahada to Dhadgaon (44 km), on the top of the Satpura Range, along the ghat road. See spectacular mountain scenery and several dolerite dykes around Dhadgaon. Carbonatite dykes have also been reported, though more difficult to locate, and the Amba Dongar carbonatite complex is just across the Narmada River from Dhadgaon, though getting to the River itself from Dhadgaon (a tribal area) requires a hike.



On the Satpura Range, at Dhadgaon

Return to Dhule by night (Dhadgaon-Shahada-Dhule, ~4 hrs.). Dinner and night stay at Dhule.

Day 5 (Feb. 3)

Depart Dhule after morning breakfast (8.30 hrs.). Turn towards Chalisgaon, and about 30 km S of Dhule, visit two E-W dykes (part of the TAPI DYKE SWARM), with profuse crustal xenoliths of the basement (gneisses, quartzites, mylonites, granulite, tuff, carbonates). These two dykes are a marvellous field rock museum, and invaluable windows to the Deccan's basement, which lies mostly hidden over a 500,000 km² expanse of the lavas.



The two Deccan dykes bearing profuse crustal xenoliths (gneisses, quartzites, mylonites...) from the Precambrian basement crust. The larger xenoliths are injected by basaltic dykelets.

Emerge on the N. H. 3 at Chandwad at 12.00 hrs. after seeing the dykes, and turn SW toward Mumbai, via Nasik, where lunch can be had. Chandwad to Mumbai takes about 5 hrs. Place of stay at Mumbai unknown as yet. **Field trip ends.** Dinner may have to be arranged by participants themselves.

Feb. 4 (to Varanasi)

Departure from Mumbai in the morning for Varanasi by flight. Arrive BHU Varanasi and complete the formalities of registration. Afternoon and evening may be free for visiting Sarnath (highly recommended), as well as Ganga ghats and boat trip (please see the IDC-6 website).

Deccan dyke swarms: Suggested reading including several recent works (NOT a complete list)

- Bhattacharji, S., Chatterjee, N., Wampler, J. M., Nayak, P. N., Deshmukh, S. (1996) Indian intraplate and continental margin rifting, lithospheric extension, and mantle upwelling in Deccan flood basalt volcanism near the K/T boundary: Evidence from mafic dike swarms. *J. Geol.*, v. 104, pp. 379–398.
- Bondre, N. R., Hart, W. K., Sheth, H. C. (2006) Geology and geochemistry of the Sangamner mafic dike swarm, western Deccan volcanic province, India: Implications for regional stratigraphy. *J. Geol.*, v. 114, pp. 155-170.
- Chandrasekharam, D., Mahoney, J. J., Sheth, H. C., Duncan, R. A. (1999) Elemental and Nd-Sr-Pb isotope geochemistry of flows and dikes from the Tapi rift, Deccan flood basalt province, India. *J. Volcanol. Geotherm. Res.*, v. 93, pp. 111–123.
- Chandrasekharam, D., Vaselli, O., Sheth, H. C., Keshav, S. (2000) Petrogenetic significance of ferroenstatite orthopyroxene in basaltic dikes from the Tapi rift. Deccan flood basalt province, India. *Earth Planet. Sci. Lett.*, v. 179, pp. 469-476.
- Chatterjee, K. K., Deshmukh, S. S. (1996) Inferring palaeostresses from mafic dyke swarms in Deccan volcanics, Maharashtra and Madhya Pradesh, India. In: Deshmukh, S. S., Nair, K. K. K. (Eds.) Deccan Basalts. *Gondwana Geol. Mag. Spec. Vol. 2*, pp. 375-391.
- Deshmukh, S. S., Sehgal, M. N. (1988) Mafic dyke swarms in Deccan Volcanic Province of Madhya Pradesh and Maharashtra. In: Subbarao, K. V. (Ed.), Deccan Flood Basalts. *Geol. Soc. Ind. Mem.*, v. 10, pp. 323-340.
- Dessai, A.G., Bodas, M. S. (1984) Occurrence of nepheline syenite around Murud-Janjira, Raigarh district, Maharashtra, India. *Curr. Sci.*, v.53, pp. 775-777.
- Dessai, A. G., Viegas, A. A. A. A. (1995) Multi-generation mafic dyke swarm related to Deccan magmatism, south of Bombay: Implications on the evolution of the western Indian continental margin. In: Devaraju, T. C. (Ed.), Dyke Swarms of Peninsular India. *Geol. Soc. Ind. Mem.*, v. 33, pp. 435-451.
- Duraiswami, R. A. (2005) Dykes as potential groundwater reservoirs in semi-arid areas of Sakri taluka, Dhule district, Maharashtra. *Gond. Geol. Mag.*, v. 20, pp.1-9
- Duraiswami, R. A., Karmalkar, N. R. (1996) Unusual xenolithic dyke at Mandaleshwar and its episodic nature. *Gond. Geol. Mag.*, v. 11, pp. 1-10.
- Karmalkar, N. R., Rege, S., Griffin, W. L., O'Reilly, S. Y. (2005) Alkaline magmatism from Kutch, NW India: Implications for plume–lithosphere interaction. *Lithos*, v. 81, pp. 101-119.
- Keshav, S., Sheth, H. C., Chandrasekharam, D. (1998) Field geology, petrography, and orthopyroxene clusters of the Dhule-Parola dyke, Tapi valley, central Deccan basalt province. *Curr. Sci.*, v. 74, pp. 252-254.
- Melluso, L., Sethna, S. F., Morra, V., Khateeb, A., Javeri, P. (1999) Petrology of the mafic dyke swarm of the Tapti River in the Nandurbar area (Deccan Volcanic Province). In: Subbarao, K. V. (Ed.), Deccan Volcanic Province. *Geol. Soc. Ind. Mem.*, v. 43, pp. 735-755.
- Ray, R. (2009) Dyke swarms in the Deccan Traps. Unpubl. Ph.D. dissertation, Indian Institute of Technology Bombay, 146 pp.
- Ray, R., Sheth, H. C., Mallik, J. (2007) Structure and emplacement of the Nandurbar-Dhule mafic dyke swarm, Deccan Traps, and the tectonomagmatic evolution of flood basalts. *Bull. Volcanol.*, v. 69, pp. 537-551.
- Ray, R., Shukla, A. D., Sheth, H. C., Ray, J. S., Duraiswami, R. A., Vanderkluyesen, L., Rautela, C. S., Mallik, J. (2008) Highly heterogeneous Precambrian basement under the central Deccan Traps, India: Direct evidence from xenoliths in dykes. *Gondwana Res.*, v. 13, pp. 375-385.

- Sheth, H. C. (2000) The timing of crustal extension, diking, and eruption of the Deccan flood basalts. *Int. Geol. Rev.*, v. 42, pp. 1007-1016.
- Sheth, H. C., Ray, J. S., Ray, R., Vanderkluyesen, L., Mahoney, J. J., Kumar, A., Shukla, A. D., Das, P., Adhikari, S., Jana, B. (2009) Geology and geochemistry of Pachmarhi dykes and sills, Satpura Gondwana Basin, central India: problems of dyke-sill-flow correlations in the Deccan Traps. *Contrib. Mineral. Petrol.* (in press).
- Vanderkluyesen, L., Mahoney, J. J., Hooper, P. R., Sheth, H. C. (2006) Location and geometry of the Deccan Traps feeder system inferred from dyke geochemistry. *Eos, Trans. Am. Geophys. Union* 87 (52), Fall Mtg. Suppl., Abstr. V13B-0681.
- Vanderkluyesen, L., Mahoney, J.J., Hooper, P.R., Sheth, H.C., Ray, R. (2008) The geochemical signature of dikes of the Deccan Traps (India): implications for the evolution of a flood basalt feeder system. IAVCEI General Assembly, Reykjavik, Iceland, Aug. 18-22, session 1-e.
- Viswanathan, S., Chandrasekharam, D. (1976) Dykes related to Deccan Trap volcanism. Proc. Symp. on Deccan Trap and Bauxite. *Geol. Surv. Ind. Spec. Publ.*, v. 14, pp. 97-107.

(Updated March 7, 2009)

