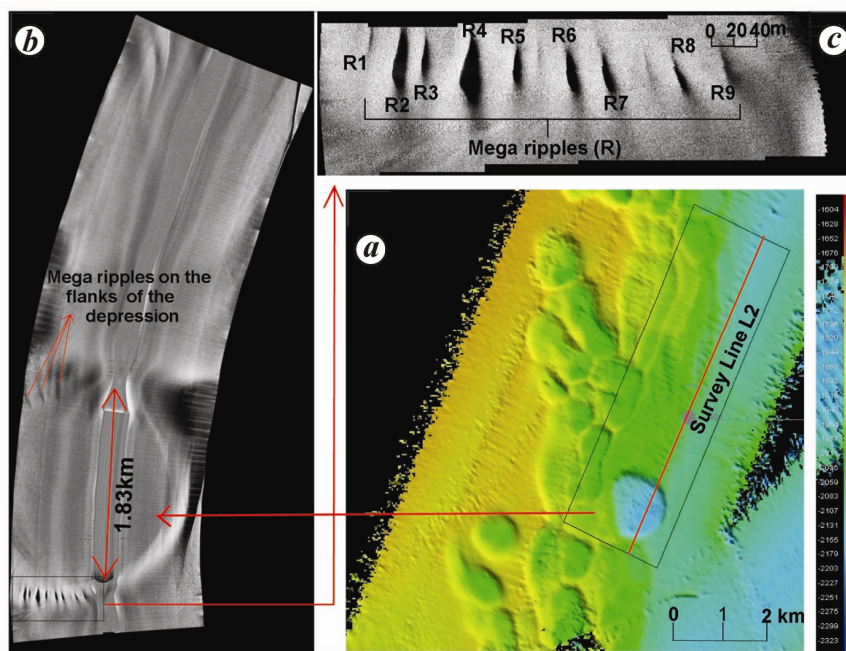# Synthetic Aperture Sonar image of seafloor

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Synthetic Aperture Sonar (SAS), modern technology for very high resolution seafloor mapping, when towed at 70–120 m above the seafloor generates high-quality backscatter image of the same with constant resolution of 40 cm × 40 cm. Research Vessel (RV) *Samudra Ratnakar* of the Geological Survey of India is equipped with Synthetic Aperture Mapping Sonar, SAMS DT-6000 (make: IXblue, France), the only one of its kind equipment in the world for civilian research purpose. The instrument capable of operations up to 6000 m water depth provides real-time georeferenced image of the seafloor at 1.6 km wide swath up to 2 kn by integrating the technology of SAS motion sensor, pressure sensor, inertial navigation system (INS) which is aided by different ancillaries as Doppler velocity log (DVL), global positioning system (GPS), ultra short baseline (USBL), sound velocity profiler (SVP) and multibeam bathymetry. The tow fish unit of the equipment has two SAS units

placed on the starboard and portside, and one gap filler multibeam echosounder unit at the middle for nadir map. The emission array in the SAS emission unit of the tow fish with 4 channels and 16 transducers transmits acoustic signals at 3.2° angle at 50 kHz frequency. The reflected signals from the seafloor are received by a SAS reception unit that has 3 sub-arrays of 4 channels and 36 oil-filled transducers placed at 6.5° reception angle on either side of the tow fish.

The instrument on-board RV *Samudra Ratnakar* was deployed for the first time in the Indian waters during the period from 3 to 8 February 2015 on the continental margin off Mangalore in 1900–2300 m water depth. Prior to deployment of the SAS unit in water, the area was mapped using a Reson Seabat 7150 multibeam echosounder to prepare a Digital Terrain Model (DTM) of the seafloor. The DTM serves as the background image for the SAS fish navigation.

On comparison of the multibeam image (Figure 1 *a*) with the SAS image (Figure 1 *b* and *c*), it is evident that the SAS image provides greater amount of information on the seabed morphology than the conventional multibeam image. The pock mark/circular depression measuring 1.83 km in diameter has further detailed features in the corresponding SAS image. The 50–100 m long and 10–20 m wide mega ripples formed on the periphery of the depression are clearly brought out by the SAS image, while such features are missing in the multibeam image. These ripples on the southern margin of the depression are denoted as R1, R2…R9 from west to east and on the northern flank of the depression (Figure 1 *b*). These features can be used to understand the prominent underwater current direction as well as for detailed morphological studies related to gas venting. The underwater current direction is detected by IXblue software on-board indirectly using the input from INS, DVL and SVP. With image resolution of this kind, the instrument can be effectively used in deep-sea mineral exploration for polymetallic nodules and seafloor massive sulphides, marine archaeological studies, underwater engineering projects, etc.

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Figure 1. *a*, Multibeam-generated digital terrain model of the survey area. *b*, Synthetic Aperture Sonar (SAS) image showing the depression. *c*, Mega ripples in the SAS image.