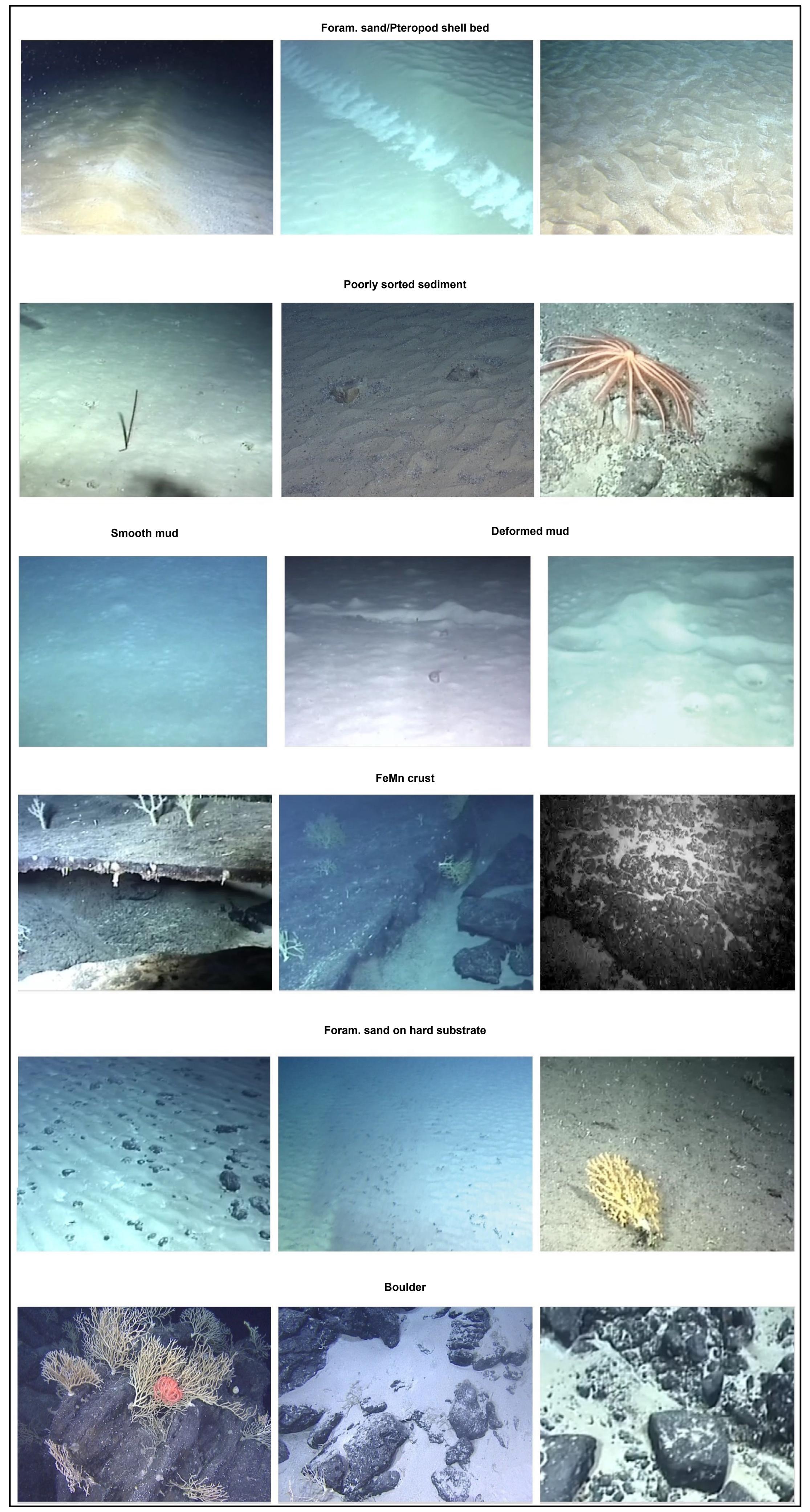
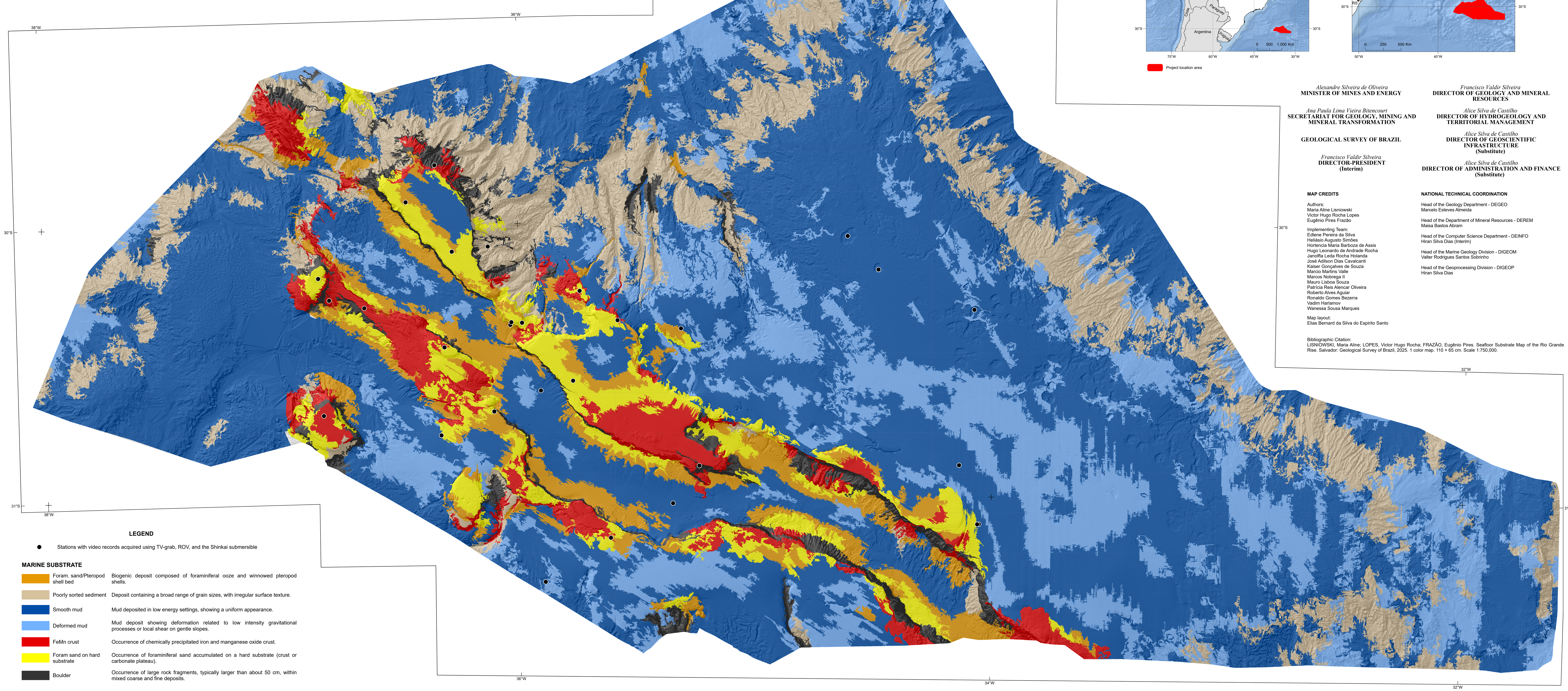
MINISTRY OF MINES AND ENERGY
SECRETARIAT FOR GEOLOGY, MINING AND MINERAL TRANSFORMATION
GEOLOGICAL SURVEY OF BRAZIL

SUBSTRATE TYPE





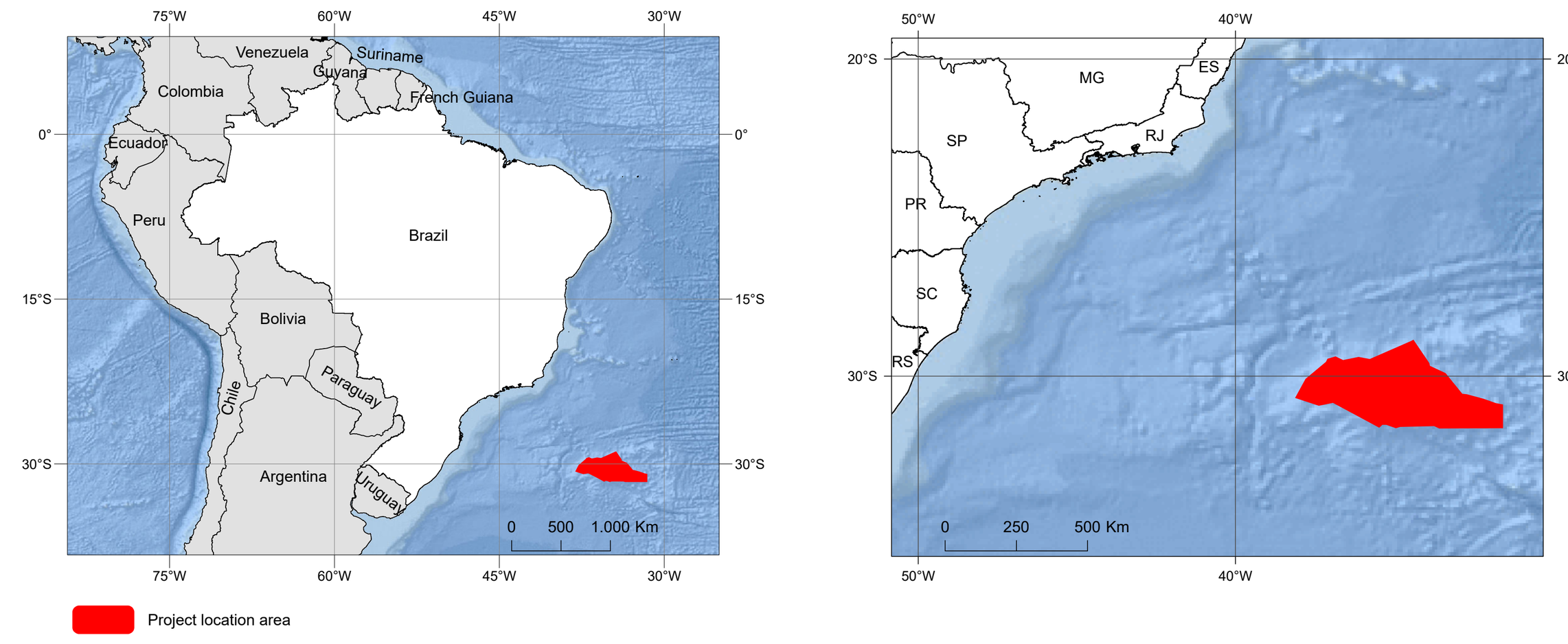
LEGEND

● Stations with video records acquired using TV-grab, ROV, and the Shinkai submersible

MARINE SUBSTRATE

Substrate	Description
Foram. sand/Pteropod shell bed	Biogenic deposit composed of foraminiferal ooze and winnowed pteropod shells.
Poorly sorted sediment	Deposit containing a broad range of grain sizes, with irregular surface texture.
Smooth mud	Mud deposited in low energy settings, showing a uniform appearance.
Deformed mud	Mud deposit showing deformation related to low intensity gravitational processes or local shear on gentle slopes.
FeMn crust	Occurrence of chemically precipitated iron and manganese oxide crust.
Foram sand on hard substrate	Occurrence of foraminiferal sand accumulated on a hard substrate (crust or carbonate plateau).
Boulder	Occurrence of large rock fragments, typically larger than about 50 cm, within mixed coarse and fine deposits.

LOCATION



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LISNIOWSKI, Maria Aline; LOPES, Victor Hugo Rocha; FRAZÃO, Eugênio Pires. Seafloor Substrate Map of the Rio Grande Rise. Salvador: Geological Survey of Brazil, 2025. 1 color map. 110 × 65 cm. Scale 1:750,000.

The Rio Grande Rise Project (PROERG) is an initiative of the Geological Survey of Brazil (SGB-CPRM), linked to the Sectoral Plan for Marine Resources (PSRM), aimed at assessing the potential of cobalt-rich ferromanganese crusts (CRFCs) on the Rio Grande Rise (RGR) - Southwestern Atlantic Ocean. Since its creation, PROERG has advanced scientific and technological knowledge on marine mineral resources of strategic relevance to Brazil. Initially part of the Program for the Prospecting and Exploration of Mineral Potential in the Area (PROAREA), the project began field campaigns in 2009 involving geophysical, geological, biological, and oceanographic surveys dedicated to mapping ferromanganese crusts and estimating their rare earth element contents, under a contract between the Brazilian Government, represented by SGB-CPRM, and the International Seabed Authority (ISA).

The technical results supported Brazil's submission to the United Nations Commission on the Limits of the Continental Shelf (CLCS), seeking the extension of the Brazilian Legal Continental Shelf in the RGR region. After the submission, PROERG became part of the Program for the Assessment of the Mineral Potential of the Continental Shelf (REMPLAC). It is currently aligned with the 2024–2027 Multi-Year Plan (PPA), within the program Ocean, Coastal Zone, and Antarctica, which focuses on strengthening scientific knowledge, supporting biodiversity conservation, and promoting the sustainable use of marine and coastal resources.

The seafloor substrate map presented here, with its bathymetry and backscatter insets, was produced from a digital bathymetric model acquired using Multibeam Echo Sounders (MBES). Data were collected by the Brazilian Navy's research vessel Sirius (H-21) in 2009 and 2010, and by the research vessel Vital de Oliveira (H-39) during expeditions between 2016 and 2023. Substrate classification is based on acoustic backscatter intensity, which reflects physical properties of the seabed such as hardness, density, and roughness. Harder and denser materials, as well as irregular or angular surfaces, generate stronger acoustic returns.

Underwater video surveys conducted between 2011 and 2018 used a TV Grab, the Shinkai 6500 submersible, and ROV-mounted HD cameras. In total, 24 sites were filmed, primarily in the central and northwestern regions, covering approximately 105 km of survey tracks. Sediment samples collected at six sites using box and push cores provided qualitative support for video-based substrate classifications through granulometric analyses and photographic documentation.

The RGR contains seven substrate types: FeMn crust, foraminiferal sand on hard substrates, foraminiferal sand and pteropod shell beds, poorly sorted sediment, boulder, smooth mud, and deformed mud, each illustrated by representative video frames. Ferromanganese crusts form dark, hard, fractured surfaces that support diverse sessile communities and overlie carbonatic platforms, often covered by thin layers of foraminiferal sand or pteropod shells deposited in low-energy settings. Smooth mud dominates deeper, low-gradient areas and transitions to deformed mud where slopes increase or bioturbation becomes more intense. Poorly sorted sediments and large boulders occur mainly in steep, topographically complex areas such as canyon walls and escarpments. Substrate heterogeneity is greatest in shallower regions and decreases toward deeper and flatter zones. The RSOBIA method integrates high-resolution bathymetry and backscatter mosaics to delineate homogeneous "objects" within the seafloor imagery, which are subsequently associated with the predefined substrate classes based on ground-truth information. Further details can be found in Lisniowski et al. (2020a; 2020b; 2025).

References

LISNIOWSKI, M. A. et al. Mapa batimétrico da Elevação do Rio Grande Central. Rio de Janeiro: CPRM, 2020a. 1 mapa color., 89 cm × 61 cm. Escala 1:700 000. (Programa Oceanos, Zona Costeira e Antártica).
LISNIOWSKI, M. A. et al. Mapa de retroespalhamento acústico (Backscatter) da Elevação do Rio Grande Central. Rio de Janeiro: CPRM, 2020b. 1 mapa color., 89 cm × 61 cm. Escala 1:700 000. (Programa Oceanos, Zona Costeira e Antártica).
LISNIOWSKI, M. A. et al. Mapping potential benthic habitats of the Rio Grande Rise, SW Atlantic. 2025. Deep-Sea Research Part I: Oceanographic Research Papers, v. 226, p. 104619, DOI: 10.1016/j.dsr.2025.104619.

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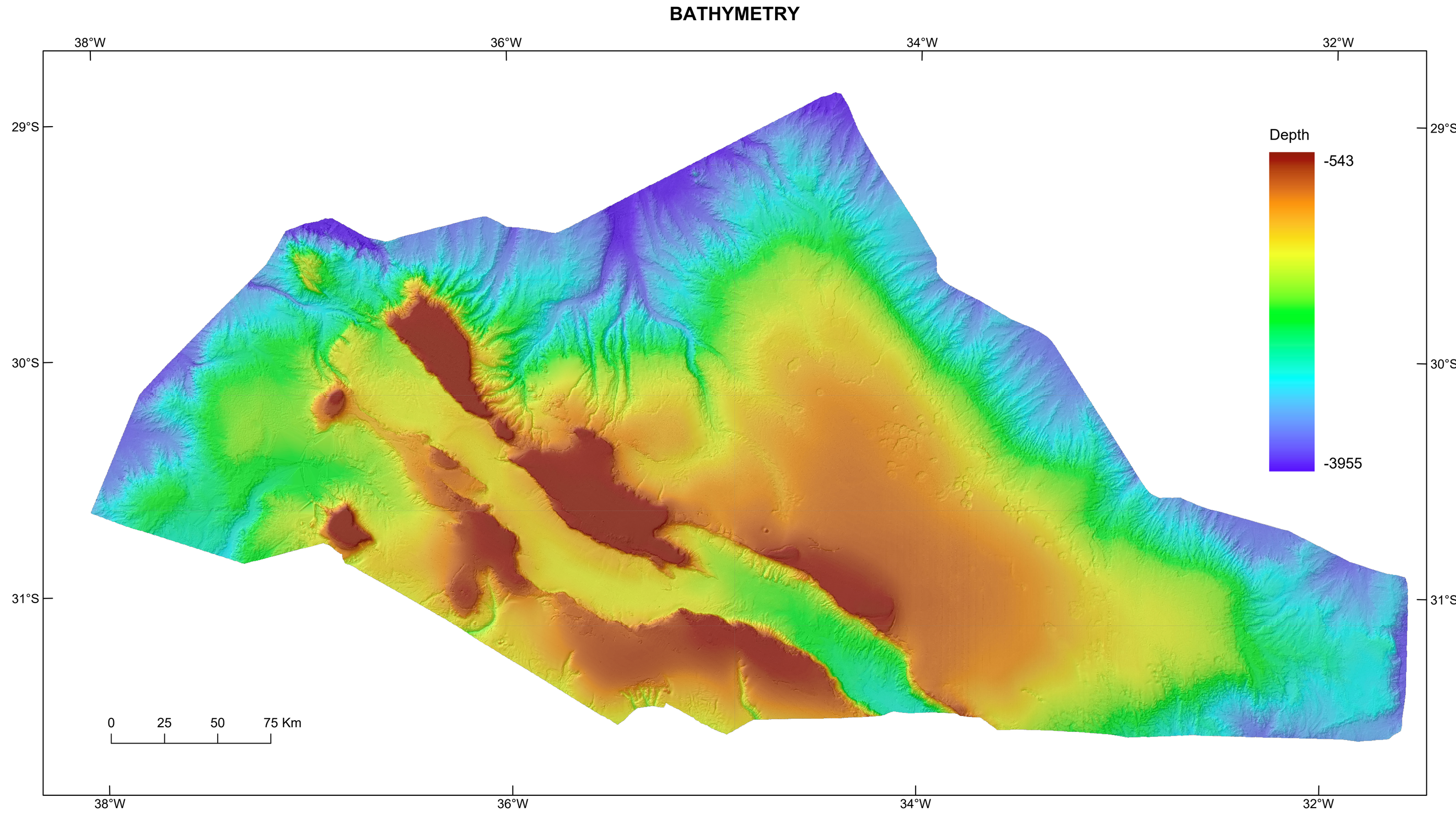
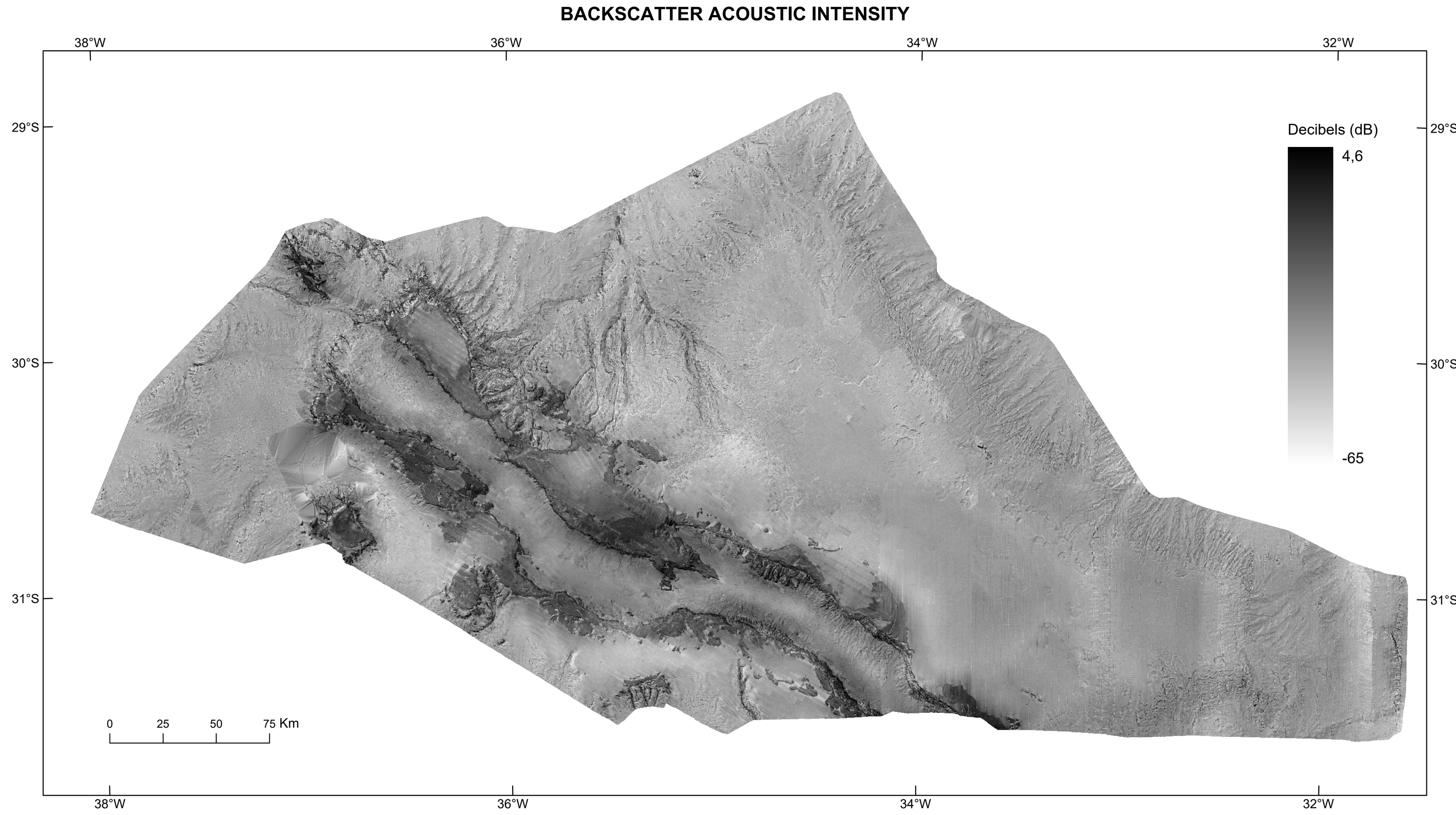
BATHYMETRY



BACKSCATTER ACOUSTIC INTENSITY



SEAFLOOR SUBSTRATE MAP OF THE RIO GRANDE RISE

SCALE 1:750,000

0 10 20 40 60 80 Km

PROJECTION: LAMBERT CONFORMAL CONIC

Geocentric Reference System: Datum: SIRGAS 2000
Latitude of Origin: 30° S
Central Meridian 35° W
Standard Parallels: 28°51' S and 31°38' S

2025

GEOLOGICAL SURVEY OF BRAZIL
MINISTRY OF MINES AND ENERGY
BRAZILIAN GOVERNMENT
STANDING WITH THE BRAZILIAN PEOPLE