

## Exploring the wreck of the Titanic: seabed processes at 3800 metres in the North Atlantic

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The wreck of the passenger liner **Titanic** lies in 3800 m of water on the continental rise adjacent to the southeastern tip of the Grand Banks of Newfoundland. Sunk on her maiden voyage 82 years ago, the **Titanic** represents a unique time gauge by which to assess environmental processes active in the deep waters of the North Atlantic. Two Russian Academy of Sciences '3 person' MIR submersibles and the research vessel **Akademik Keldysh** were contracted by IMAX Corporation in June 1991 to film a large format documentary and to conduct a scientific investigation of the wreck site. Seventeen submersible dives averaging 14 hours in duration were completed. State-of-the-art broadcast quality video, 3-D video, IMAX 70 mm film, and wide angle still photographic imagery of the wreck site were acquired. Bottom sediment core samples and metal fragments were recovered by remote manipulators on the MIR 2 submersible. The wreck lies in 2 pieces on the floor of Titanic Canyon. The intact bow and badly damaged stern sections are separated by 600 m. Initial findings suggest the seabed at 3800 m depth is more environmentally active and dynamic than anticipated. Bottom currents up to 1 knot were observed. Patches of active, wave generated symmetric sand ripples are located in close proximity to the wreck and debris field. In response to current action, a thin veneer of recent sediment is being pre-

erentially deposited in the leeward areas of the decks. Seabed sediments consist of surficial recent soft muds and sands, 10 to 15 cm thick, unconformably overlying dense friable clays of infinite radiocarbon age. At the unconformity, approximately 20 m of the dense clays have been eroded since deposition. More resistant beds subcrop on the canyon floor as 3 m high ridges or scarps covered with the recent soft muds. 'Icicles' of rust or rusticles hanging from the wreck are frequently bent or curved by prevailing currents. Corrosion appears to be controlled more by biological rather than chemical processes. Fauna inhabiting the wreck site are more abundant, with twice the diversity anticipated by biologists. Twenty-four species of invertebrates (crabs, shrimps, anemones, sponges, starfish, corals, etc.) and four species of fish, including large Grenadier or rat-tail fish, were observed. Metallurgical analysis of a recovered hull plate fragment indicates that the ship's plating was brittle, suggesting that the iceberg damage was more extensive than previously thought. The scientific program was a joint project with the Russian Academy of Sciences, CANMET, Petro-Canada, the National Geographic Society, and the Geological Survey of Canada, and was funded by IMAX Corporation and the Federal Program on Energy Research and Development (PERD).