subducted along the northwestern margin of the Pacific between about 90 and 55 Myr ago. Examination of volcanics from these ancient arcs should therefore hold a record of the composition of the long-vanished Izanagi oceanic plate. Evidence supporting the existence of Indian-type Izanagi oceanic crust may therefore be present in the lead isotope signatures of volcanic rocks from ancient volcanic arcs found along the northwest Pacific margin.

Furthermore, the presence of Indian-type mantle beneath the northwest Pacific Ocean supports the notion that the boundaries of mantle domains evolve over much longer timescales than the more transient plate tectonic processes. The distinct isotopic signatures of the Earth's main mantle domains are thought to reflect long-term segregation, and the boundaries between domains have been related to mantle convection patterns[4]. The distinctive isotopic signature of the Indian mantle domain has been attributed to a deep mantle source[5,6], with possible localized upwelling from the lower mantle spreading out to replenish the entire domain[4]. However, the northwest Pacific mantle may have been effectively separated from the main body of Indian-type mantle and its mode of replenishment since at least the beginning of the Cretaceous period by a wall of downgoing slabs located along much of the western boundary of the northwest Pacific Ocean[2] (Fig. 1).

Future studies of the compositional signature of the mantle should lead to a better understanding of the mechanisms controlling the formation and evolution of mantle domains. ❐

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ATMOSPHERIC SCIENCE

Failure to launch

NASA's long-awaited carbon-dioxide-observing satellite was lost shortly after lift-off on 24 February 2009 at 09:55 GMT. The clam-like structure that encapsulated the Orbiting Carbon Observatory (OCO) apparently did not open. With the extra weight, the satellite failed to make orbit, re-entering the atmosphere and disintegrating over the Southern Ocean a few minutes later. The launch received widespread media attention, with climate scientists from all corners of the globe registering their disappointment about the loss. But what are the scientific implications of this disaster?

The OCO was built with the intention of better understanding the size and location of carbon dioxide sources and sinks over the entire globe (*Nature Geosci.* **2,** 3–4; 2009). While sources, including fossil fuel combustion and other human activities, are rapidly increasing the amount of carbon dioxide in the atmosphere, natural sinks, such as the oceans and terrestrial plants, are continuing to absorb about half of the carbon dioxide that we emit. Unfortunately, both the sources and sinks are poorly resolved by ground-based measurement networks: stations are sparse over the ocean basins, in the tropics and elsewhere in the developing world. It was hoped that OCO would improve our understanding of carbon exchange between the surface and the atmosphere in these regions. It was also expected that the data generated by OCO would provide information on the efficacy of future land-management policies and carbon-sequestration technologies, which may be put in place to optimize carbon sequestration and limit carbon dioxide emissions.


ORBITAL SCIENCES CORPORATION

Even though the OCO launch failure is a real blow to the carbon-cycle and climate-change communities, all is not lost. The OCO was one of two satellites designed to monitor atmospheric carbon dioxide concentrations across the globe in the coming years. The other one — the Japanese Aerospace Exploration Agency's Greenhouse gases Observing SATellite (GOSAT) — launched successfully on 23 January of this year, and at present its performance is being monitored as it orbits the Earth. The two missions were meant to be complementary — the OCO was designed to provide measurements of carbon dioxide concentrations with unprecedented sensitivity and spatial resolution along narrow, pole-to-pole tracks, whereas GOSAT is designed to monitor both carbon dioxide and methane concentrations at lower spatial resolution over larger areas of the globe. Although these two satellites together would have provided unprecedented sensitivity, resolution and coverage of the global carbon cycle — pinpointing the size and location of natural carbon dioxide sinks and sources — GOSAT alone can provide some of this information.

Indeed, GOSAT will soon provide the data-starved carbon-cycle community with thousands of global measurements of carbon dioxide and methane each month. The loss of the OCO will limit what we can learn about natural carbon dioxide sinks — which are diffuse and unlikely to generate a strong atmospheric signature, compared with the measurement sensitivity of GOSAT. This may mean that sinks need to be quantified over larger spatial and temporal scales. However, GOSAT should provide us with a robust understanding of natural and human-produced carbon dioxide sources, which tend to be more localized and intense, generating a stronger atmospheric imprint. Carbon-cycle researchers will now focus on the vast quantities of data that GOSAT will generate, while hoping for a mission with the precision and detail of OCO to fill in the picture.

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