above. The resulting relatively warmer mixture, so-called Antarctic Circumpolar Current bottom water, feeds all eight branches that radiate away from the Southern Ocean at depths greater than 3,500 m, and subsequently joins the global ocean circulation.

Because of its unique role in climate, the Southern Ocean will continue to receive ample attention from oceanographers, despite the extraordinary challenges of working in as hostile an environment as the Antarctic region. Clear signs of warming in both Antarctic Bottom Water and Antarctic Circumpolar Current bottom water have been detected for the past decade, thanks to large-scale international collaborations.

Vital oceanographic measurements, such as those reported by Fukamachi and co-authors[2] from the Kerguelen Plateau, will continue to benefit climate scientists. However, many active components of the Southern Ocean overturning circulation still need similar attention[6,7]. ❐

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PLANETARY SCIENCE

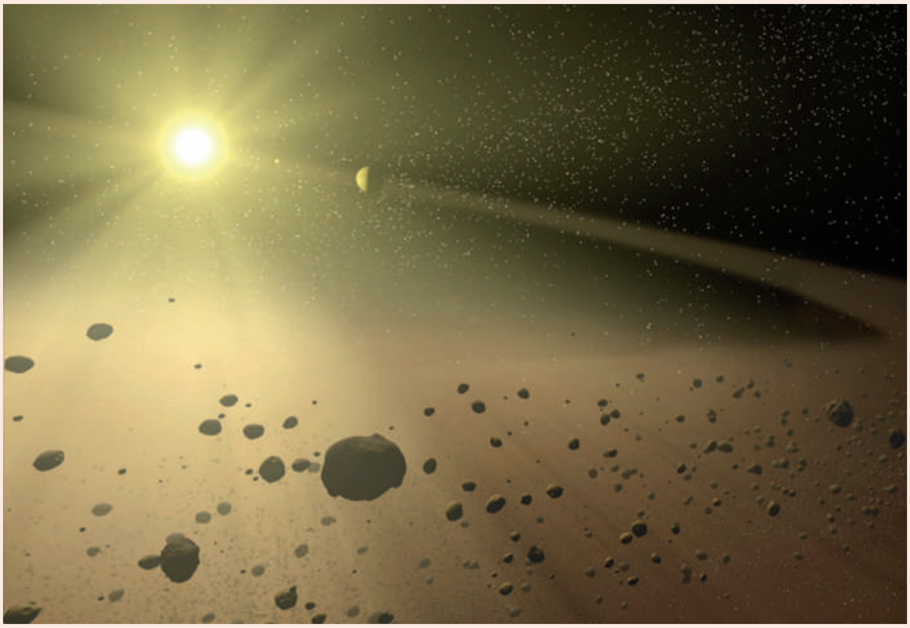
Comet–asteroid continuum

Within our Solar System there exists an abundance of small, rocky bodies. Of these, asteroids and comets have traditionally been divided into two distinct classes, based on their orbital cycle and composition. Comets were thought to follow more eccentric orbits than asteroids, and to originate from the outer Solar System. Asteroids, on the other hand, were thought to originate from the inner Solar System. Comets also contained abundant frozen volatiles, including water ice, that asteroids seemed to lack.

But the boundary between comets and asteroids has blurred in recent years, with the discovery of small bodies that are depleted in volatile substances, yet follow cometry orbits, and bodies that seem to contain volatiles but follow typical asteroid orbits. These findings suggest that, rather than two distinct end members, an entire range may exist between comets and asteroids.

Further evidence in support of a comet–asteroid continuum is reported in *Nature* (*Nature* **464,** 1320–1321 and 1322–1323; 2010). Two independent groups, one headed by Humberto Campins, the other by Andrew Rivkin and Joshua Emery, have measured water ice on the surface of an asteroid.

Both groups studied 24 Themis, one of the largest asteroids within the main asteroid belt located between Jupiter and Mars. They assessed the spectra of the sunlight reflected from the surface of 24 Themis using NASA's Infrared Telescope Facility, and



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discovered that it was completely covered with ice.

The presence of ice on 24 Themis is surprising. The asteroid lies in relatively close proximity to the Sun, so any surface ice should rapidly vaporize and disappear. The ice could have been recently delivered to the asteroid through collisions with ice-rich comets. However, for 24 Themis both teams favour the hypothesis that ice exists as a stable reservoir beneath the surface of the asteroid. In this scenario, collisions with other small bodies disturb the surface — a process known as impact gardening — exposing the ice that is buried in the reservoir. Under sunlight the ice would vaporize. When cooled, the vapour would condense to form a fine coating of frost around surface grains.

Measurements of 24 Themis also reveal the presence of organic compounds on the asteroid's surface, the origin of which remains unknown. Observation of both surface water-ice and organic material supports the theory that asteroids, through past impacts with Earth, may have supplied our planet with the water and organic compounds required to initiate life.

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