Abstractions

FIRST AUTHOR

Across the subduction zones of Japan, where one tectonic plate dives beneath another, the propagation of seismic waves varies from place to place. Earth scientist Ikuo Katayama of Hiroshima University in Japan sought to find out why. By using a high-pressure device to squeeze serpentine, a hydrous mineral, to determine how its crystal orientation would develop, he and his colleagues simulated what might happen in the Japanese subduction zones (see page 1114). Katayama tells *Nature* more.

What inspired the study?

I realized that in some subduction zones, data on seismic anisotropy — the fact that seismic waves move at different speeds according to their direction — could not be explained by the classical idea that wave propagation depends on the crystal orientation of the mineral olivine, a major constituent of Earth's mantle. We wanted to test a newer idea that serpentine might contribute to seismic anisotropy. Serpentine can form in the mantle, where tectonic plates converge.

How did you conduct your experiment?

We simulated the conditions of the subducting-plate interface by cooking the materials thought to be present in Earth's mantle at high pressure and temperature. We then analysed the crystal orientation of the deformed minerals using scanning electron microscopy and computed the seismic anisotropy.

What did you learn?

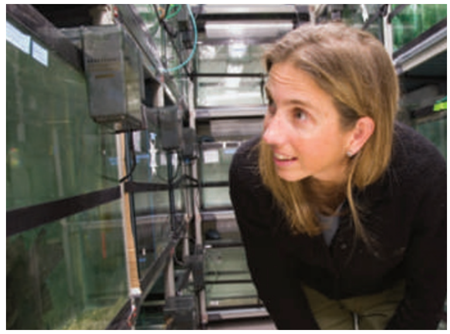
We found that the crystal orientation that results when serpentine forms at such high temperature and pressure could explain the seismic anisotropy observed in subduction zones such as the Ryukyu arc, an island arc that connects southwest Japan and Taiwan.

What can your findings tell us about the subduction process more generally?

Water is transported into Earth's interior at subduction zones and has important roles in volcanism and seismic activity. Serpentine's presence in subduction zones suggests that water can be released at shallow depths in a warm subduction zone such as the Ryukyu arc. Serpentine can form in warm subduction zones as water is ejected from the descending plate and reacts with mantle rocks. It is not expected in dry conditions. In a cold subduction zone, such as that in northeast Japan, water is not supplied to the shallow mantle wedge. The heterogeneous distribution of water — or serpentine — that we propose may cause distinct geological processes in warm and cold subduction systems. This may be why seismic activity differs between these regions. ■

MAKING THE PAPER

Catherine Peichel



New fish sex chromosome holds key to aggressive mating.

When Catherine Peichel and her colleagues went fishing for genes underlying behavioural evolution in a population of sticklebacks, they were prepared for a long haul. It was worth the wait; the five-plus years of work netted a great catch. The group found genetic evidence that a stickleback population living in the Japan Sea has a new sex chromosome that accounts for its males' aggressive mating behaviour.

Peichel became interested in stickleback behaviour shortly after starting her current lab at the Fred Hutchinson Cancer Research Center in Seattle, Washington, in 2003. Jun Kitano, a postdoc who had joined her lab from Japan, told her about two groups of fish in Japanese waters that look similar but exhibit strikingly different mating behaviours. Three-spine sticklebacks from the Pacific Ocean swim in a zigzag pattern, whereas those from the Japan Sea roll over.

Despite these differences, both fish share a mating ground, breeding in Lake Akkeshi and the Bekanbeushi Marsh in Japan's northern island. In the spring of 2003, Peichel's group visited the area. When Japanese fishermen brought their daily haul ashore, Peichel and her group looked for spiny creatures that might have been caught along with the more commercial species. They spent many cold, wet mornings plucking fish from nets and sorting them into two groups by examining the bony plates, or keels, on the fishes' tails. The Pacific Ocean stickleback sports a broader keel than its Japan Sea counterpart.

The researchers sent their live catch to Seattle. In the lab, Kitano spent hundreds of hours recording the fishes' behaviour. He noticed that, in addition to performing different moves from Pacific Ocean fish, the Japan Sea males were more aggressive with their females — vigorously bumping them from underneath and pricking them with their spiky dorsal fins. "It's pretty dramatic," Peichel says of the behaviour.

To delve into the genetics of these behavioural differences, the group crossbred the two fish populations over two generations. Having analysed the mating behaviours of the adult male progeny resulting from the crosses, the researchers extracted DNA from the fish to look for genetic markers that were inherited along with either of the two behaviours.

The team found that male fish that performed the aggressive bumping had inherited a piece of chromosome 9 from the Japan Sea sticklebacks. Chromosome 9 is not a sex chromosome in other stickleback populations, but Peichel's group discovered that, in the Japan Sea population, it is always inherited together with — or linked to — a sex chromosome. "The fact that the two chromosomes are linked was weird, because we had done lots of genetic mapping and had never seen that result," Peichel says.

So the team turned to microscopy to get a close-up look at the fishes' chromosomes. The analysis showed that certain genetic elements, or markers, that the team had earlier mapped to two separate chromosomes — chromosome 9 and a sex chromosome — in other three-spine stickleback populations were fused together during evolution into a new sex chromosome in Japan Sea sticklebacks. This seems to be responsible for the aggressive mating behaviour (see page 1079). Although sex chromosome regions tend to change little in mammals and birds, they evolve quickly in fish and some amphibians. "How and why this occurs is still a really big mystery," says Peichel. ■

FROM THE BLOGOSPHERE

The day has come for an online-only Nature journal. *Nature Communications* is open for submissions, writes publishing executive editor Maxine Clarke on the Nautilus blog (http://go.nature.com/fOpE4f).

Launching in spring 2010, the journal aims to rapidly publish top-notch research in all areas of the physical, chemical and biological sciences. A 'hybrid' journal, it will offer both subscription-based and open-access options for publication. Staff will aim to publish papers within 28 days of acceptance. *Nature Communications* will not only provide a faster route to publication for all, but will also plug some gaps not covered by other Nature research journals, such as palaeontology and high-energy physics.

Although no area will be excluded from consideration, "the editors particularly welcome submissions from cross-disciplinary fields including biophysics, physical chemistry, environmental science and mathematical biology," writes Clarke. She adds that the online-only model will enrich manuscripts with "innovative web technologies, including interactive browsing and efficient data- and text-mining." ■

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