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RESEARCH TOPICS FROM JAMS: NEW STUDY FINDS SUBDUCTED CARBON MAY WEAKEN SUBDUCTION INTERFACES

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The deep carbon cycle within the Earth has a significant impact on the surface environment on geologic timescales. The subduction zone is a critical region of the deep carbon cycle. An enormous amount of carbon is subducted as carbonate or organic carbonaceous matter in sediments, and the amount and form of carbon varies greatly from one subduction zone to another. For example, subducting sediments in the NE Japan subduction zone contain a large amount of organic carbon, whereas subducting sediments in the SW Japan subduction zone are characterized by the presence of both inorganic and organic carbon (e.g., Clift 2017). However, the influence of subducting carbon on the chemical reactions and mechanical properties at the subduction interface remains poorly understood.

A new study led by Oyanagi and Okamoto, published in *Nature Communications*, shows that talc and carbonate mineral can form at the base of the mantle wedge over a wide range of depths in warm subduction zones. This study highlights the role of carbon-rich fluids originating from subducted carbon on mechanical properties at the subduction interface. They presented numerical modeling to predict the characteristics of the fluid (chemical composition and fluid flux) and the mineral assemblages at the subduction interface, taking into account variations in the shape of the subducted carbon and the thermal structure of the typical cold subduction zone of NE Japan and the warm subduction zone of SW Japan. Their calculations showed that the chemical composition and fluid flux in the two subduction zones are very different. In the NE Japan subduction zone, H_2O-rich fluids rich in silicon and sodium are released due to sediment dehydration (Fig. 1A), whereas in the SW Japan subduction zone, carbon-rich fluids are released (Fig. 1B). Furthermore, in the NE Japan subduction zone, dehydration of subducted sediments did not occur at 30–60 km, whereas in the SW Japan subduction zone, dehydration of subducted sediments occurs continuously from shallow (35 km) to deep depths (80 km).

In both subduction zones, the supply of water can lead to the formation of serpentine, a hydrous mineral, in the forearc mantle. However, according to their calculations, the difference in the amount and composition of fluids generated in the two subduction zones caused significant changes in the types and amounts of altered minerals in the forearc mantle at the subduction interface. In the forearc mantle of NE Japan, carbonate minerals are not formed, and talc is formed only at a depth of about 70 km (Fig. 1C). In contrast, in SW Japan, both talc and magnesite are produced over a wide range of depths from 35 to 70 km, and the amount of these minerals increases from a depth of 40 km, with thicker layers existing at greater depths (Fig. 1D).

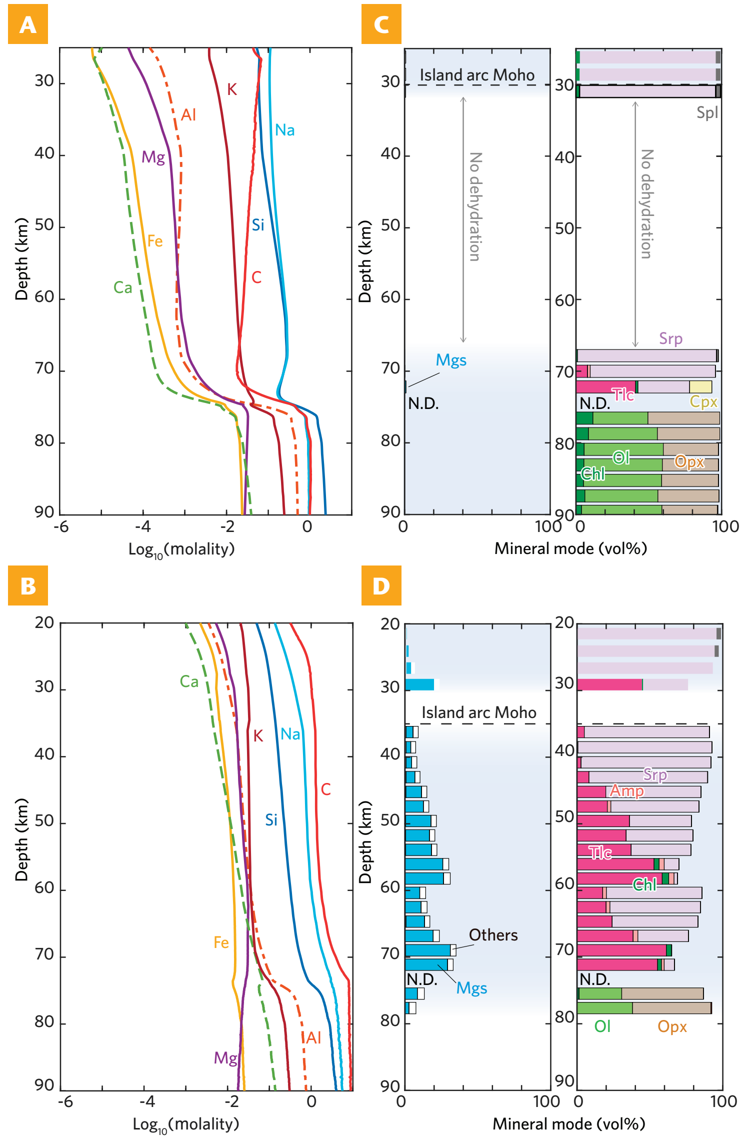

Figure 1 Predicted composition of fluid in equilibrium with metasedimentary rocks along the slab top *P–T* path of (**A**) NE Japan and (**B**) SW Japan subduction zones. (**C**) Predicted mineral proportions (left) and proportion of carbonate (right) in the mantle wedge adjacent to subducting sediments in the NE Japan subduction zone. (**D**) Predicted mineral proportions (left) and proportion of carbonate (right) in the mantle wedge adjacent to subducting sediments in the SW Japan subduction zone.

Slow earthquakes (earthquakes that occur more slowly than normal earthquakes) have been observed at depths of 30-40 km at the plate boundary in the SW Japan subduction zone, and at even greater depths, the region becomes a stable sliding zone (non-earthquake slip; Fig. 2). Interestingly, the depth at which the thick talc layer was predicted in the SW Japan subduction zone (40 km or deeper; Fig. 1D) coincides with the down-dip limit of the seismic zone containing slow earthquakes. Talc has a very low coefficient of friction, is known to cause stable sliding (e.g., Hirauchi et al. 2013), and is widely observed at metapelite–ultramafic rock contacts in metamorphic terranes (Okamoto et al. 2021; Okamoto and Oyanagi 2023; Oyanagi et al. 2023). The present study proposes that in the SW Japan subduction zone, carbon cycling from the surface

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FROM THE MGPV CHAIR

We are delighted to finally be joining *Elements*, and excited to be part of the growing and increasingly interlinked network of international societies focused on mineralogy and geochemistry. As the Mineralogy, Geochemistry, Petrology, and Volcanology (MGPV) Division of the Geological Society of America (GSA), we have a wide range of shared interests with the *Elements* community and welcome the opportunities for engagement and collaboration that this new affiliation will bring.

Many of you may be familiar already with MGPV from participation in the annual GSA Connects meetings, where our Division has been active for the past 15 years, sponsoring and promoting technical sessions in the areas of mineralogy and geochemistry. Our interests encompass diverse areas of mineralogy and geochemistry, spanning a wide disciplinary range from basic to applied science, surficial to deep Earth systems, and terrestrial to Solar System–wide materials and processes. In addition to promoting scientific sessions in these areas, MGPV is highly dedicated to supporting students and early career scientists, providing opportunities for community building, career-development, research funding, travel grants, and other awards. We look forward to growing our student and international communities, and hope that many of you will choose to engage with us in the near future.

Elisabeth Widom, MGPV Division Chair

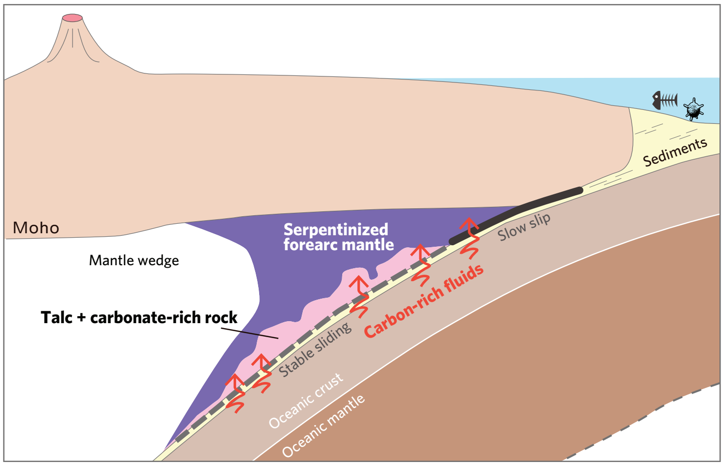

FIGURE 2 Cross-sectional illustration of the observed seismicity and predicted mineralogy in the SW Japan subduction zone.

to the Earth's interior increases the amount of talc and carbonate with depth, facilitating the mechanical weakening of the plate boundary and the transition from a seismogenic to a stable sliding zone (FIG. 2).

The amount of carbon stored in seafloor sediments is closely linked to the Earth's surface environment, including atmospheric CO_2 concentrations and climate. This study suggests that long-term changes in the Earth's surface environment and the characteristics of seafloor sediments around the world have an impact on the occurrence of earthquakes and the mechanical properties of plate boundaries in the Earth's interior.

MGPV (Helpful neumonic: MaGnesium PeroVskite)

The Mineralogy, Petrology, Volcanology, and Geochemistry (MGPV) Division is one of 22 scientific divisions of the Geological Society of America. It was founded in 2009 with a mission to promote the study, teaching, and research of Earth's materials, chemical cycles, processes, and resources—critical areas for sustainable resource management, hazard mitigation, and exploration of Earth and other planets. The Division achieves these goals by organizing and sponsoring sessions at both national and regional meetings. Additionally, it supports the field through initiatives such as the Distinguished Geological Career Award (DGCA), Early Geological Career Award (EGCA), student research and travel grants, exhibits, and joint receptions with its Adhering Societies.

The MGPV Division currently has 1,894 members, including 870 students and 208 early-career professionals. Ninety-two percent of MGPV members reside in North America. It is governed by a board consisting of five elected officers, three student representatives, and representatives from each of the Adhering Societies: Clay Minerals Society, Geochemical Society, Mineralogical Association of Canada, Mineralogical Society of America, Mineralogical Society of Great Britain & Ireland, and the International Association of Geochemistry.

In 2024, MGPV and its Adhering Societies organized or endorsed 84 half-day technical sessions (27 of which were poster sessions) at the Annual Meeting in Anaheim, CA. During this event, J. Michael Rhodes of the University of Massachusetts (USA) and Chris Yakymchuk of the University of Waterloo (Canada) were honored as the 2024 Distinguished Geological Career Award (DGCA) and Early Career Geological Award (ECGA) recipients, respectively. Additionally, the MGPV Division funded 41 exceptional student research projects, awarding a total of $102,500 from the Lipman, Carmichael, Hollister, and MGPV Funds. It also supported 10 student travel grants, totaling $5,000, thanks to generous donations and endowments.

Looking ahead to the 2025 GSA Annual Meeting in San Antonio, TX (October 19–22), MGPV will host award sessions recognizing the upcoming DGCA and ECGA awardees, Anita Grunder of Oregon State University and Madison Myers of Montana State University, along with student award recipients. MGPV's student representatives will be organizing the third annual MGPV student sessions.

For more information about the MGPV Division's current and past activities, visit the division's website (https://community.geosociety.org/mgpvdivision/home), where you can explore newsletters, annual reports, and details on awards and grants. MGPV also uses social media as a tool for outreach and communication: LinkedIn and Slack. For any inquiries, please use the "Contact Us" section on the site.

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