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News & Views

Origin of the Yellow Sea: an insight

Yaoling Niu · Jie Tang

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Niu et al. [1] recently show that the basement of the Chinese continental shelf (beneath East China Sea and South China Sea) is geologically unrelated to the continental lithosphere of eastern China, but is of exotic origin. This alien/exotic terrane of a sizeable mass with large compositional buoyancy (either an oceanic plateau or a micro continent) was transported along with the Pacific plate that spread in the course of NW direction and subducted beneath the eastern margin of the continental China in the Mesozoic. Collision of this buoyant and unsubductable alien terrane with the continental China jammed the trench and terminated the subduction at ~100 Ma. This conclusion comes from a detailed analysis of the distribution of Jurassic-Cretaceous granitoids (~190 to ~90 Ma) throughout the entire eastern continental China in space and time. The termination of the granitoid magmatism at ~90 Ma signifies subduction cessation at this time or shortly beforehand, e.g. at ~100 Ma. The jammed trench is predicted to locate on the Chinese continental shelf in the vicinity of, and parallel to, the Southeast coastal line, whose curved arc-shape is actually inherited from the pre-100 Ma arc-shaped trench. To locate this Mesozoic plate boundary to the north in the Yellow Sea region and beyond is not straightforward because of the more recent (<30 Ma) tectonic re-organization associated with the opening of the Sea of Japan. The latest finding of the younger granitoids (as young as ~56 Ma) in the Russian Far East by Tang et al. [2], together with the presence of younger granitoids in South Korea and Southwest Japan (as young as 71 Ma) (Fig. 1a), presents us an impetus for addressing some unanswered questions of [1] and also offers insights into the tectonic evolution of the region, including the nature and origin of the Yellow Sea:

> *The Yellow Sea is a continent-rifted basin with buried basaltic seafloor basement although the said seafloor spreading must have ceased for some time.*

This apparently brave hypothesis is unfamiliar to the community and differs from some long-held interpretations and popular perceptions, but it is the result of observation-based reasoning and logical analysis, which deserves serious consideration. The purpose of this *News and Views* paper is to encourage the community to discuss and debate on this important problem towards the genuine understanding of the tectonic evolution of the region in a global context.

Despite the effort over the years [3–5], plate tectonics reconstruction in the broad northwestern Pacific region remains largely speculative and unconstrained [1]. For example, geological and geophysical data indicate that the landmass of Japanese islands was separated from the eastern margin of the Eurasian continent in response to the backarc basin (the Sea of Japan) opening in the time frame of ~30–15 Ma [6, 7], but this and other landmasses of the greater region had been in the same relative positions with

Y. Niu (✉) · J. Tang
Department of Earth Sciences, Durham University, Durham DH1 3LE, UK
e-mail: yaoling.niu@foxmail.com

Y. Niu
Institute of Oceanology, Chinese Academy of Sciences, Qingdao 266071, China

Y. Niu
Qingdao National Laboratory for Marine Science and Technology (Marine Geology), Qingdao 266061, China

J. Tang
College of Earth Sciences, Jilin University, Changchun 130061, China

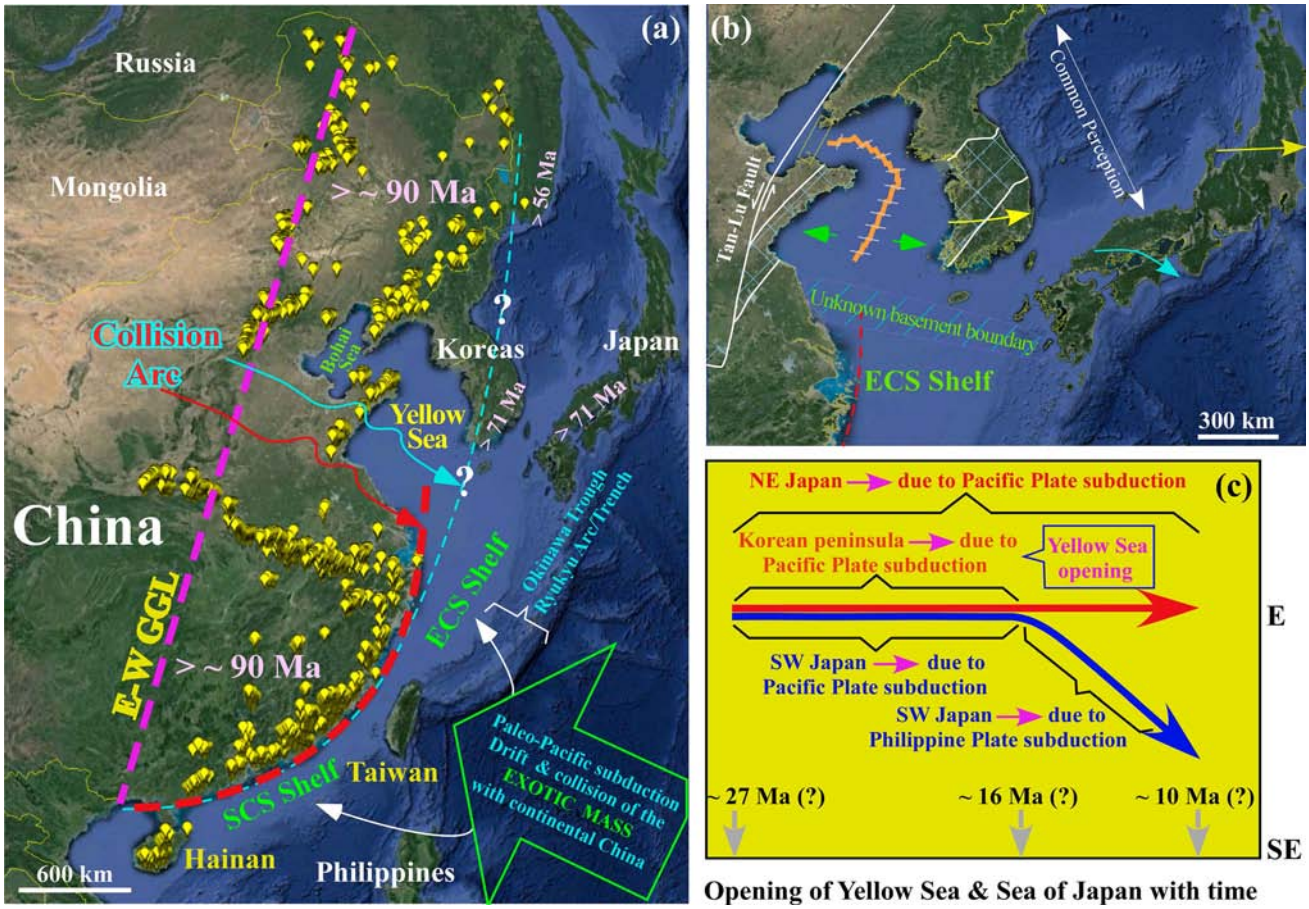

Fig. 1 **a** Modified from [1], showing the eastern continental China and adjacent lands and seas (Google Map, 2015) to illustrate the alien/exotic origin of the basement of the Chinese continental shelf beneath East China Sea (ECS) and South China Sea (SCS) [1]. No granitoids of $<\sim$90 Ma are found in eastern China [1], but the younger granitoids in the Russian Far East (as young as $\sim$56 Ma) and Korean Peninsula and Southwest Japan (as young as $\sim$71 Ma) [2] offer an insight into the origin and nature of the Yellow Sea (YS). **b** Portion of **a** to show that the YS basement is not a continental shelf, but developed from continental rifting, rift opening, together with the opening of the Sea of Japan (SoJ), as a backarc basin in response to paleo-Pacific subduction. That is, the landmasses of Japan and the Korean Peninsula must have been connected with eastern China before the rifting and opening. We predict that basaltic crust and failed rift (as indicated) should exist and be geophysically detected beneath the thickened sediments and sedimentary rocks. The Dabie-Sulu Orogenic belt indicated with mesh patterns correlate well with the same patterned terrane on the Korean Peninsula [2–4]. The opening of the Bohai Sea resulted from northward rift propagation of the YS, but its present geometry and basement morphology must be largely controlled by the active (once highly active) left-lateral Tan-Lu Fault. The yellow rectangle indicates that the Liaodong and Shandong peninsulas should remain largely connected as manifested by the chain of islets extending >65 km from south to north. The double-arrowed white line across the SoJ is the common perception of the SoJ backarc opening. **c** Qualitative illustration of the opening of the YS and SoJ with time. The basaltic seafloor of the SoJ has been recognized (ODP Legs 127 and 128), but the absence of (or unknown yet) magnetic anomaly patterns [5] makes it difficult to locate the spreading center, but we propose as follows: The opening of the YS and SoJ may have begun $\sim$27 Ma (the $\sim$27 Ma old basaltic seafloor rocks in the SoJ) in response to the paleo-Pacific subduction until $\sim$10 Ma (the youngest seafloor basalt) as indicated by the arrowed red line and represented by the drift of the Northeast Japan in **b**. The seafloor spreading of the YS may have stopped at $\sim$16 Ma when the Philippine Plate came to subduct northwestwards, causing the southeastward drift of Southwest Japan. That is, the Southwest Japan experienced eastward drift before $\sim$16 Ma and then southeast drift, giving rise to the clock-wise rotation. This is consistent with our inference [2] and the fact that the basement of Southwest Japan shows affinity with the Cathaysia Block in South China [1]

the same geometries as they are at present in global reconstruction models although backarc spreading histories are indicated [5]. The most intriguing question in the context of the geological evolution of eastern China since the Mesozoic concerns the nature and origin of the Yellow Sea [1]. In this communication, we briefly discuss our view on the geological origin of the Yellow Sea, which is unfamiliar to many, but is a logical and testable hypothesis thanks to the finding of younger granitoids in the Russian Far East [2]. We discuss the reasoning towards the hypothesis and suggest ways with which to test the hypothesis.