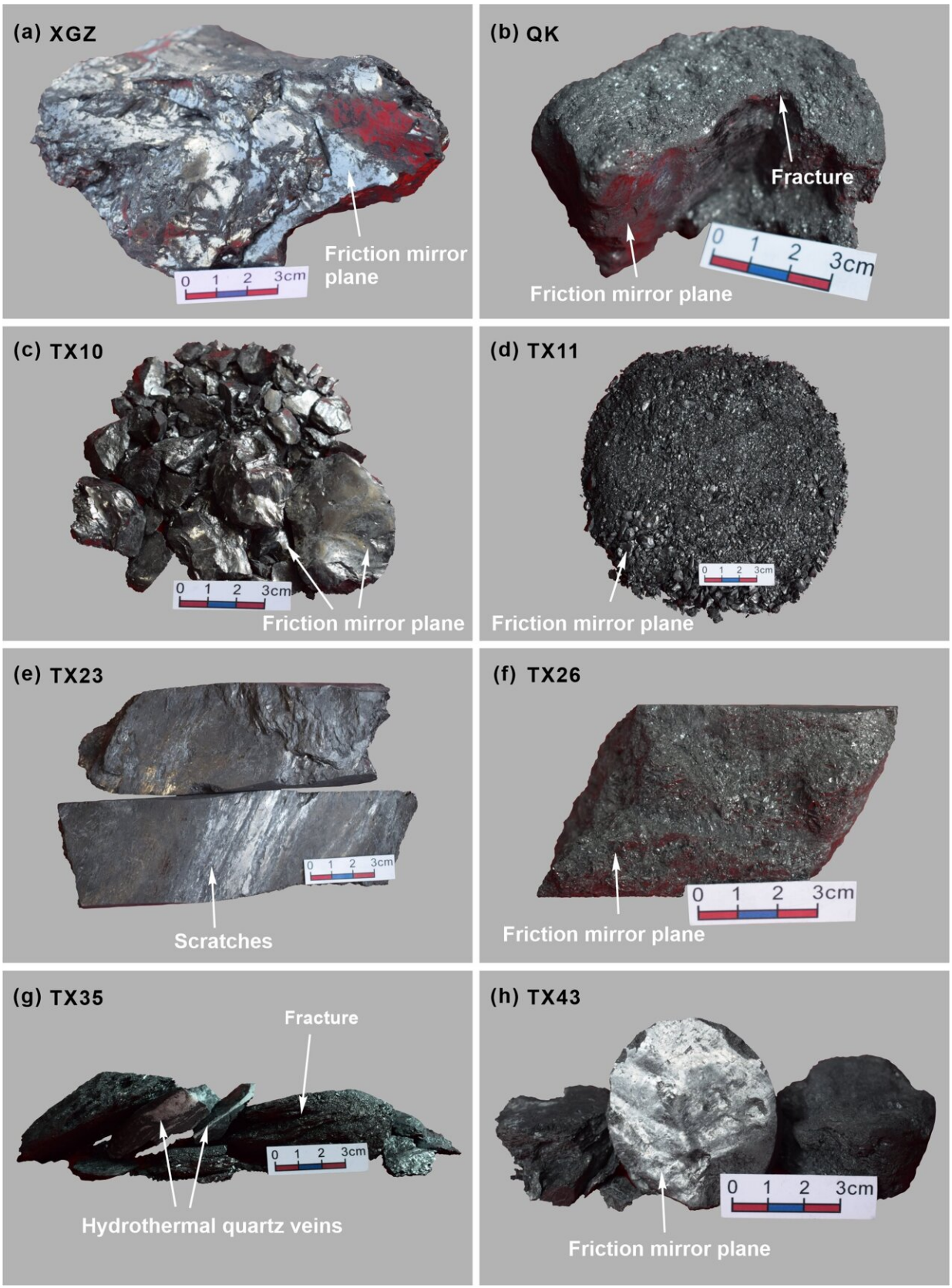
Discovery of the largest natural carbon onions on Earth

September 26 2022

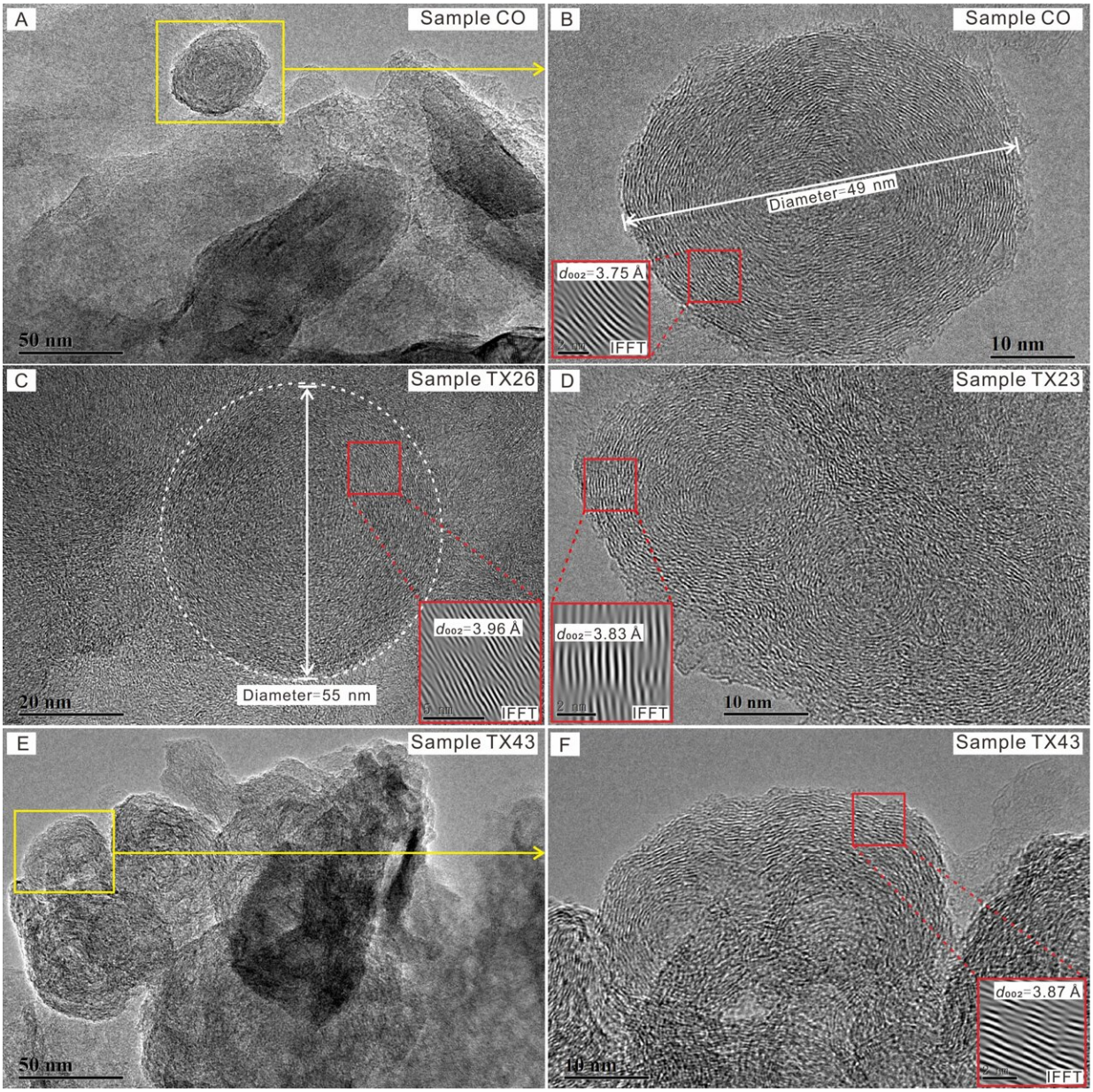

(a) XGZ
Friction mirror plane
0 1 2 3cm
(b) QK
Fracture
Friction mirror plane
0 1 2 3cm
(c) TX10
0 1 2 3cm
Friction mirror plane
(d) TX11
0 1 2 3cm
Friction mirror plane
(e) TX23
0 1 2 3cm
Scratches
(f) TX26
0 1 2 3cm
Friction mirror plane
(g) TX35
Fracture
0 1 2 3cm
Hydrothermal quartz veins
(h) TX43
0 1 2 3cm
Friction mirror plane

(a) Tectonically deformed coal with large-scale irregular friction mirror planes for sample XGZ; (b) fractures and friction mirror planes in sample QK; (c) well-developed friction mirror planes in sample TX10; (d) loose small coal particles in sample TX11; (e) scratches in sample TX23; (f) small-scale friction mirror planes in sample TX26; (g) hydrothermal quartz veins in sample TX35; (h) friction mirror planes in sample TX43. Credit: Science China Press

Recently, a study led by Dr. Yilin Chen, Prof. Yong Qin, Dr. Jiuqing Li, Associate Prof. Zhuangfu Li, Tianyu Yang (China University of Mining and Technology) and Dr. Ergang Lian (Tongji University) was published in *Science China Earth Sciences*. The research team identified natural carbon onions (onion-like fullerenes) in intrusion-affected coal samples collected from Permian coal-bearing strata in the Yongan Coalfield, Fujian Province, South China. They found the largest natural carbon onions (with an outer diameter of ~55 nm) ever recorded on Earth.

Granite porphyry intrusions and quartz hydrothermal veins are abundant in the Permian coal-bearing strata in this coalfield. All samples collected were tectonically deformed coals with highly developed structural fractures, friction mirror planes, and maximum vitrinite reflectance values of 4.0–9.5%. Natural carbon onions observed in the coal samples had single or multiple cores, with 24–46 graphitic shells characterized by outer diameters of 24–55 nm.

The maximum vitrinite reflectance, outer diameter, and graphitic shell number of carbon onions in the intrusion-affected coal were positively correlated, indicating that the carbon onions were secondary products formed during coal metamorphism owing to magmatic intrusion. The research team believes that carbon onions in intrusion-affected coal are synthesized by chemical vapor deposition.



single-core natural carbon onions (Fig. a–c); multi-core natural carbon onions (Fig. d–f). Credit: Science China Press

The researchers also found that many graphite-like pyrolytic carbons fill in cracks or cavities in coal samples, which are newly formed

constituents derived from vapor-phase deposition during the high-temperature coking of coal by intrusions. Therefore, the research team speculates that natural carbon onions synthesized by CVD, similar to pyrolytic carbon, may also preferentially fill in cracks and fissures. This may be the reason for the uneven distribution of natural carbon onions in intrusion-affected coals.

More information: Yilin Chen et al, Discovery of the largest natural carbon onions on Earth, *Science China Earth Sciences* (2022). DOI: 10.1007/s11430-021-9951-x

Provided by Science China Press