Professor unearths the ancient fossil plant history of Burnaby Mountain

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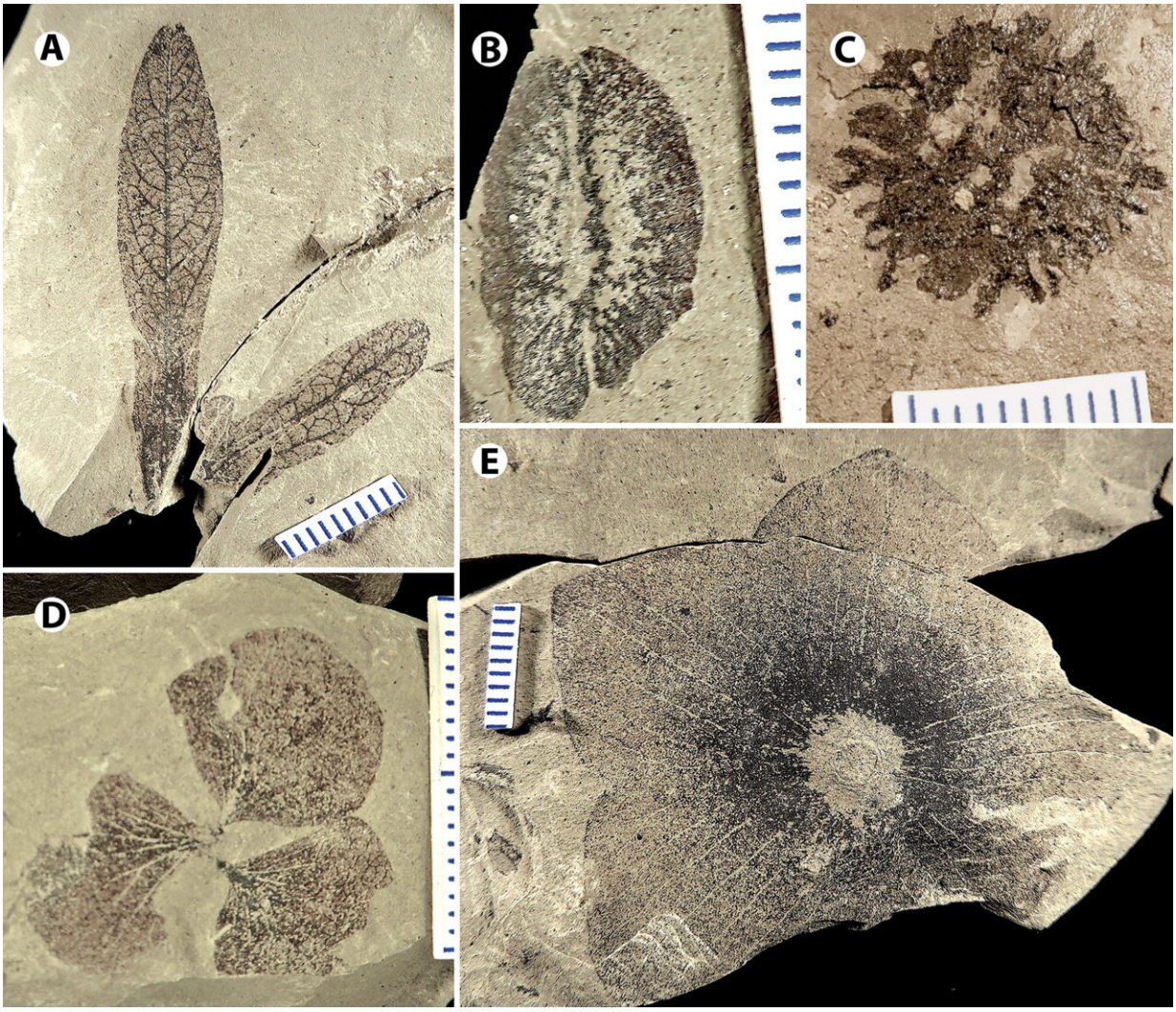


Reproductive plant macrofossils from the Simon Fraser University exposure. A, Partial trilobed fruiting bract of Palaeocarya cf. P. wolfei, similar to bracts of living Engelhardia. B, Fruit valve of the malvaceous Craigia. C, Liquidambar

fruit cluster showing the woody elongated styles of the embedded capsules. D, Sterile flower of Hydrangea. E, Floral calyx of Florissantia cf. F. speirii. The species is uncertain but based on the large size of the calyx (diameter = 51 mm), which is most similar to F. speirii. All scales are in millimeters. Credit: Simon Fraser University

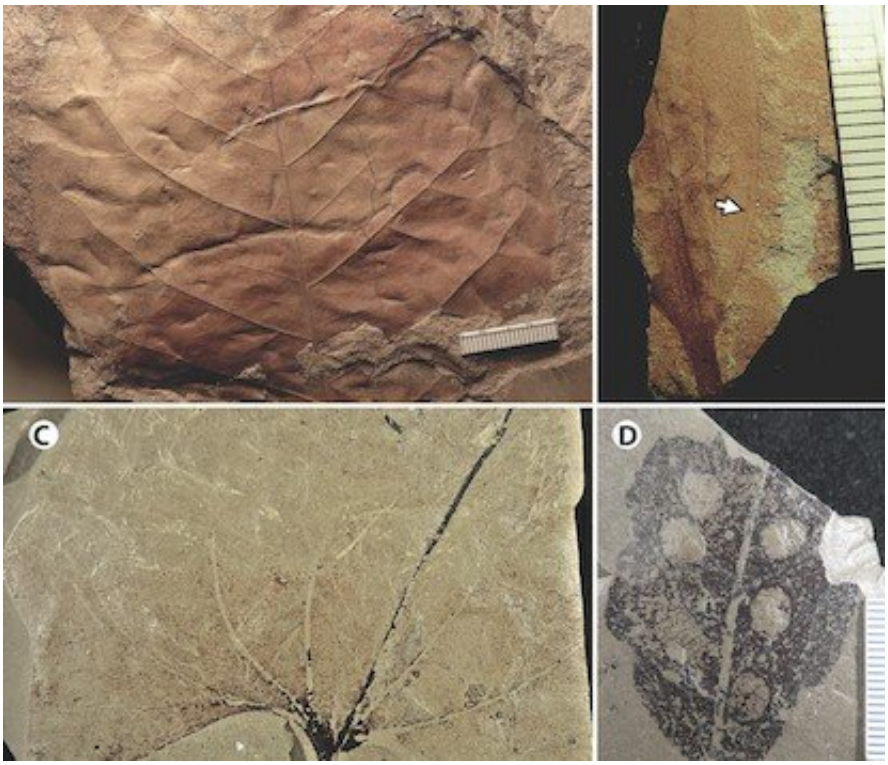
New research led by Simon Fraser University paleobotanist Rolf Mathewes provides clues about what plants existed in the Burnaby Mountain area (British Columbia, Canada) 40 million years ago during the late Eocene, when the climate was much warmer than it is today. The results of their plant fossil analysis were recently published in the *International Journal of Plant Sciences*.

As an undergraduate, Mathewes and his supervisor at the time, professor Robert C. Brooke, found and collected plant fossils from a deposit exposed during the construction of the university in the late 1960s. The fossils were kept at SFU but remained locked away in cabinets for many years until Mathewes returned to the collection as a professor. He dedicates the paper to the memory of Brooke, his late supervisor and mentor.

One of the fossils identified by their colleague David Greenwood, from Brandon University, is of a palm leaf fragment. The team also identified a hydrangea flower and the flower of an extinct plant from the same family as the basswood, a tree native to Eastern North America. A microscopic analysis of fossil pollen extracted from the fine shale also reveals the presence of alders, ferns, elms, sweetgum, and many other plants.

"These plant fossils tell us the climate was warm temperate to subtropical because of the presence of palms," says Mathewes, study

lead and SFU professor of paleoecology & palynology. "If you wanted an analogue for what the climate was like compared to today, the conditions would be similar to the East Coast of the United States somewhere around Wilmington, North Carolina, where palms are still native today."



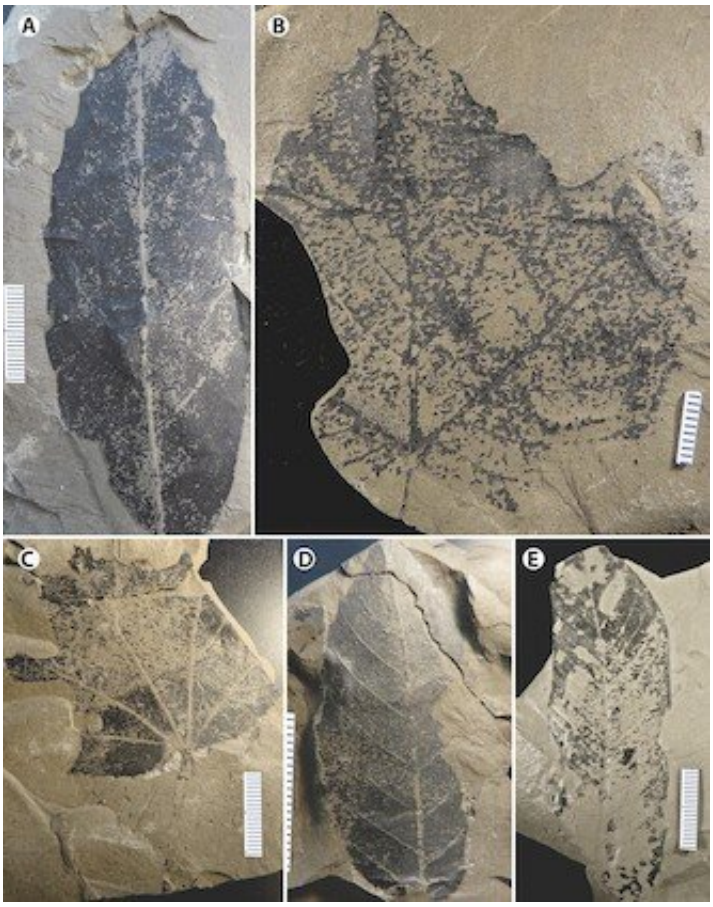
A, Large leaf of cf. Anacardites franklinensis, a species defined by Wolfe from the Eocene Puget Group. B, One of several leaf fragments of an uncertain Myrtaceae (Syzgoides), based on an entire-margined leaf with a strong midvein and thin, closely spaced eucamptodromous secondaries that connect to an intramarginal vein (arrow). C, Unidentified cordate leaf with actinodromous venation, entire margin, and fimbrial vein visible along lower margin, suggestive of Menispermaceae. D, Insect body fossils have not been found in the Burnaby Mountain sediments, but some examples of insect leaf damage are present, like this unidentified dicot leaf with rounded skeletonized feeding spots. All scales are in millimeters. Credit: Simon Fraser University

Study co-author Tammo Reichgelt (University of Connecticut) used new climate modeling techniques to confirm the warmer conditions.

Although planted palms can be found growing in the Lower Mainland today, Mathewes notes that these plants would not survive in British Columbia on their own as they did in the distant past.

"Even if they flowered and produced seeds, their young seedlings would never be able to compete with the seedlings of Douglas fir and hemlocks and alders that are our native vegetation and probably would die in the first hard frost of winter," he says.

He explains that most of Burnaby Mountain is comprised of sandstone and gravel but the fossils are only preserved on shale or mudstone. In the late Eocene, Burnaby Mountain had not yet formed and was a flood plain, like the Fraser River Delta, with ponds and river channels with vegetation growing near sea level.



Selected dicot leaves. A, Dryophyllum pugetensis leaf confirming craspedodromous venation, with teeth concentrated in distal portion of lamina, and showing a slight trend to falcate curvature. B, Leaf of Platanus with distinctive platanaceous teeth at leaf tip. C, Basal portion of cf. Acer leaf, with long petiole and basal actinodromous primary venation. D, Leaf of cf. Alnus, craspedodromous with two tooth sizes. Alder pollen is also present. E, Leaf of cf. Rhamnus, with dense apically curving semicraspedodromous secondary veins. This leaf closely matches morphology of extant Rhamnus purshianus but does not show the minute teeth at the leaf edge. All scales are in millimeters. Credit: Simon Fraser University

The plants and trees growing on the flood plain deposited their leaves, flowers and pollen into the fine sediment of a shallow lake or pond. Their fossils formed through a process of being compressed under layers

of sediment for millions of years.

One of the fossil leaves clearly displays round feeding marks made by an insect, and Mathewes says there is still much to be discovered, identified and studied from the pollen samples and a second fossil deposit site.

More information: Rolf W. Mathewes et al, Plant Megafossils, Palynomorphs, and Paleoenvironment from the Late Middle to Late Eocene Burnaby Mountain Flora, Huntingdon Formation, British Columbia, Canada, *International Journal of Plant Sciences* (2023). DOI: 10.1086/724156

Provided by Simon Fraser University