GSA Data Repository 2016091

## The oldest Pinus and its preservation by fire

Howard J. Falcon-Lang et al.

## Supplementary discussion: Justification for a new species

Plant fossils are usually preserved in a disarticulated state, and new taxa are described based on individual organs; there are very few taxa reconstructed as 'whole-plants'. The new *Pinus* fossils described here comprise remains of partial twigs, with short shoot bases, lacking fertile remains. We note that there is a paucity of anatomically-preserved pinaceous twigs in the Cretaeous fossil record. Prior to this paper, the oldest described twig material is from the Cretaceous (Cenomanian) of the Czech Republic, some 40 million years younger than our new *Pinus* fossils; however, that material is assigned to family level only, and all other Cretaceous fossils that are similar to modern pines are based on secondary xylem only, and therefore assigned to genera such as *Pinuxylon* (Peralta-Medina and Falcon-Lang, 2012) rather than *Pinus sensu stricto*. Based on the antiquity, rarity, good preservation, and genus-level identification of the new material, it is advantageous to apply a binomial name, to allow its discussion in the literature.

As the material is assignable to the extant genus, *Pinus*, it is also necessary to consider how the fossil differs from the c. 115 extant species. *Pinus* is subdivided into two subgenera, *Pinus* Pinus and *Pinus* Strobus (Farjon, 2010). *Pinus* subgenus Strobus shows, typically, five needles per fascicle, whereas *Pinus* subgenus Pinus, shows, variably, 1 to 8 needles per fascicle (Farjon 2010). Our new *Pinus* fossils consistently show two needles per fascicle suggesting an affinity with *Pinus* subgenus Pinus (Farjon, 2010), and implying that the two subgenera diverged earlier than previously thought (Gernandt et al., 2011).

In *Pinus* subgenus Pinus, the number of needles per fascicle is species-specific in the range of (1) 2 - 5 (8) needles per fascicle (Farjon 2010). Two needles per fascicle is a stable characteristic of the 19 species of so-called 'Old World Pines' only: *P. densata, P. densiflora, P. hawnshanensis, P. kesiya, P. latteri, P. luchuensis, P. massoniana, P. merkusii, P. mugo, P. nigra, P. resinosa, P. sylvestris, P. tabuliformis, P. taiwanensis, P. thunbergii, P. tropicalis, P. uncinata, and P. yannanensis* (Farjon, 2010). A few additional species may show two needles per fascicle but in these taxa, the number of needles per fascicle is highly variable (1-5), unlike the stable two needle state observed in our material (Farjon, 2010).

Another important character state of the new *Pinus* fossils is their 3/8 phyllotaxic fraction. The most common phyllotaxic fractions in *Pinus* subgenus Pinus approximate to 1/3, 2/5, 3/8, and 5/13 (Farjon, 2010). Of the classic 'Old World Pines' that show two needles per fascicle, the most common fractions are 2/5 and 5/13 (Farjon, 2010). Only *P. sylvestris* and *P. nigra* has a phyllotaxic fraction that commonly and closely approximates to 3/8 (i.e., 135°) (Farjon, 2010). According to the analysis of the wood of 352 conifer species compiled by Esteban et al. (2004), the new fossil *Pinus* differs from *P. sylvestris* and *P. nigra*, and most other 'Old World Pines' based on the absence of alternate ray tracheids. Therefore, the fossil material can justifiably be treated as a new species.



Falcon-Lang et al. 2016. The oldest Pinus and its preservation by fire. Geology, v. 44, p. 303-306