

Dating the emergence of sequestrate fungi in Australia, using an augmented meta-analysis

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*This talk will summarise a paper recently published in Australian Systematic Botany

The formation of sequestrate (truffle-like) fruit-bodies has long been linked to dry climates, as supported by a high diversity of sequestrate fungi in these environments. Australia is an example of one such place that is rich in truffle diversity and is a predominantly dry region. However, Australia was not always so arid but was once wet and supported extensive rainforests. The process of drying out began after Australia separated from Antarctica (approximately 32 million years ago) and began moving north. If aridity was a key driver in the evolution of sequestrate morphologies then we would expect sequestration to have only occurred post-separation and the onset of drying. To test this idea, the dates of sequestrate nodes in Australia were compiled both from published, dated phylogenies (four lineages) as well as estimated from sequences available on GenBank that were processed in BEAST using a secondary calibration method (nine lineages). The lineages were chosen from the Agaricomycetes because this class represents a high phylogenetic diversity of sequestrate taxa in Australia. Taxon sampling was biased to maximise the number of non-sequestrate to sequestrate nodes of Australian taxa. Results of the analyses of individual lineages found the Hysterangiales to be the earliest group tested to become sequestrate, around 83 million years ago, but the majority of sequestration in Australia occurred much more recently. To test whether this pattern of recent evolution was real or by chance (as more nodes in general are expected to be seen more recently), models were created and compared. The models suggested there was an increased rate of sequestration in Australia at some point between 34 and 13 million years ago (during the Oligocene and Miocene). Although this time window coincides with the separation of Australia from Antarctica and the subsequent aridification, it also overlaps with the radiation of potential mycorrhizal plant associates, and the emergence of specialised mycophagous mammals. While aridification cannot be the sole driver of sequestration, due to the early establishment of the Hysterangiales, it is still likely to have had a major influence on the diversity of sequestrate fungi in Australia.

日本語摘要 | 地下生菌の多様性が非常に高いオーストラリアにおいて、気候の乾燥化とトリュフ類の多様化が同時期に始まったのかを検証した。現在のオーストラリア大陸は Gondwana 大陸起源であり、現在の南極大陸から分断した 3200 万年前以降に乾燥化が進んだ。そのため、乾燥化とシクエストレート型形態への進化がリンクしているとする、3200 万年以後に起こったはずである。ハラタケ綱を対象として、発表された系統情報および GenBank のシーケンスデータをもとに、計 9 系統の分岐年代を推定したところ、ヒステランギウム目（約 8300 万年前）を除く大部分の系統は、シクエストレート型への進化が 3400 万年～1300 万年ころに加速したことが示唆された。この推定値はシクエストレート化が気候の乾燥化にともなうという仮説と矛盾しなかったが、同時期には外生菌根性樹木や菌食性動物の多様化が起こったことも示されている。乾燥化がシクエストレート化の唯一の要因とは言えないまでも、有力な作業仮説として今後も検証する必要があるであろう。

Sheedy, Ryberg, Lebel, May, Bougher and Matheny. 2016. Dating the emergence of truffle-like fungi in Australia, by using an augmented meta-analysis. Australian Systematic Botany 29: 284-302.