Fungi in a Warmer World - Fungal diversity from the Peak Warming of the Miocene Climate Optimum as Recorded in the Latah Formation, Clarkia, Idaho, USA

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INTRODUCTION

Microfungi are a vital part of ecosystems as they help with key processes, such as carbon and nutrient cycling, especially through the actions of mycorrhizal and saprotrophic members (Nuñez Otaño et al., 2015, 2021; Willis et al., 2018). Microfungi can also be good indicators of plant biodiversity in an area because many fungal taxa are host-specific (Rutten et al., 2021; Francioli et al., 2021; Hu et al., 2021; Wijayawardene et al., 2022). Despite being crucial components in ecosystems, they are often overlooked. In the fossil record, microfungi have a high preservation rate and they are often preserved close to the original substrate they were deposited in. This makes them an important proxy for understanding local past ecological and climatological conditions (Romero et al., 2021, O'Keefe et al., 2017).

The Fungi in a Warmer World project seeks to use fossil fungal assemblages to study changes in biodiversity during the Miocene Climate Optimum (MCO), a period of peak warming that closely mirrors current and projected warming trends (Steinthorsdottier et al., 2021). The current atmospheric CO_2 concentration is around 420 ppm but is rapidly approaching the MCO average of 450-550 ppm (Steinthorsdottier et al., 2021).

This study is looking at sediments from just below ash layer RA3 through 2m above, corresponding to pollen zones 1-3 of Pipis and Rember (2013) from the upper portion of the Latah Formation Clarkia lagerstätten exposed at locality P-37 near Fernwood, Idaho (Figure 1) . This poster is the first step in a focused study of sediments deposited during peak MCO warming (15.31Ma). Previous studies have been conducted in the area and show that the section is organic rich and contains exceptionally well-preserved plant fossils and abundant palynomorphs (Pipis et al., 2012). These studies also suggested that the lake was surrounded by a warm to warm-temperate forest similar to forests in the southeastern United States and eastern China today (Smiley and Rember, 1985a, b). A few studies have been done over the fungi present on leaves from the deposit, but preserved fungal biodiversity data is exceptionally scarce (Sherwood-Pike, 1985, Sherwood-Pike and Grey, 1988).

This study seeks to fill a gap in knowledge about Miocene fungal assemblages from the Northwestern United States. Results from this study will be part of a global fungal distribution dataset that will be used for climate modeling and to predict how fungi will react to future warming trends.

STUDY AREA

The Clarkia lagerstätten is part of the upper Latah Formation in Idaho (Figure 2). The sediments in this exposure of lacustrine sediments are primarily clay and silt with layers of ash (Steinthorsdottier et al., 2021). The sample site is located at the P-37 locality with a focus on sediments just below through 2m above ash bed RA-3 (Figure 2) . This site was chosen based on the abundance of paleobotanical material (leaf fossils) (Smiley and Rember, 1985a, b, 1981, Smiley et al, 1975) and also a preliminary study on pollen and spores completed in this area (Pipis, 2012).

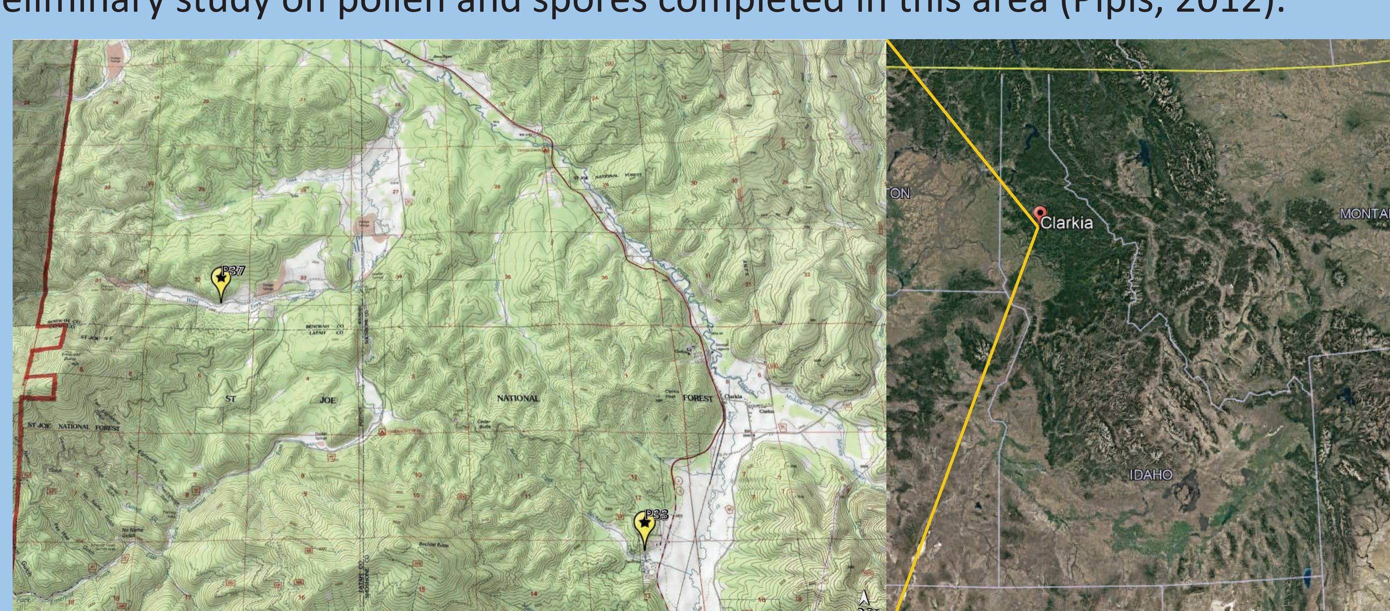
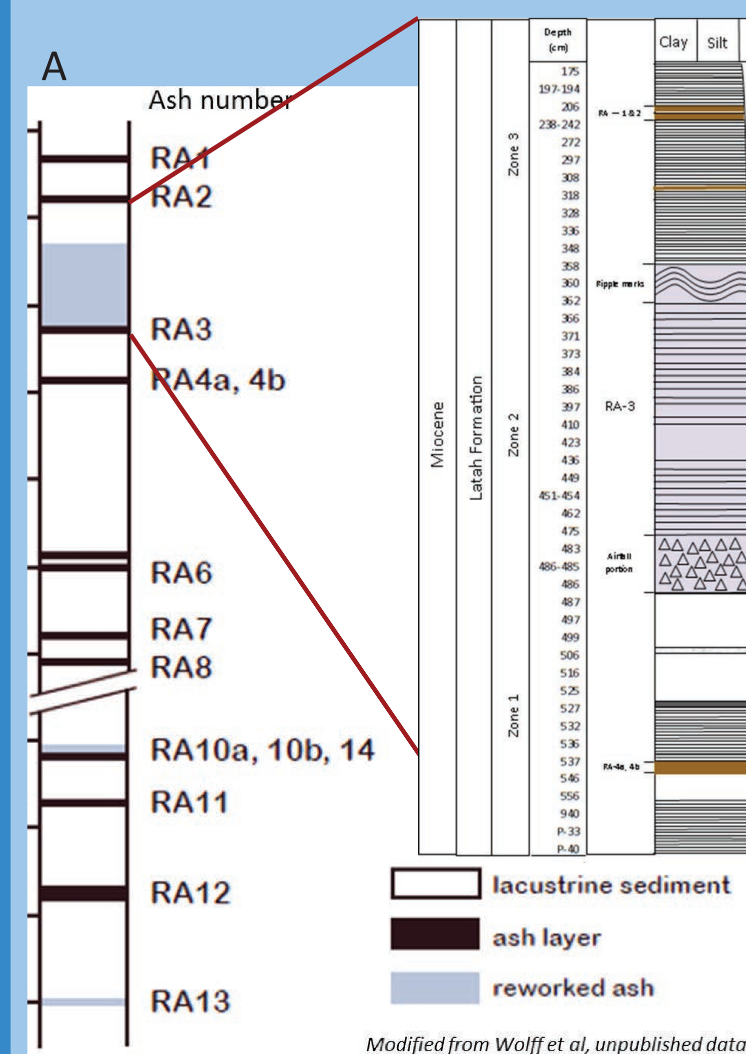


Figure 1. Study Area - The Clarkia lagerstätten is exposed at two main sites, P33 near Clarkia, ID, and P37 in Rural Fernwood, ID. This study concentrates on sediments exposed in the upper part of site P37.



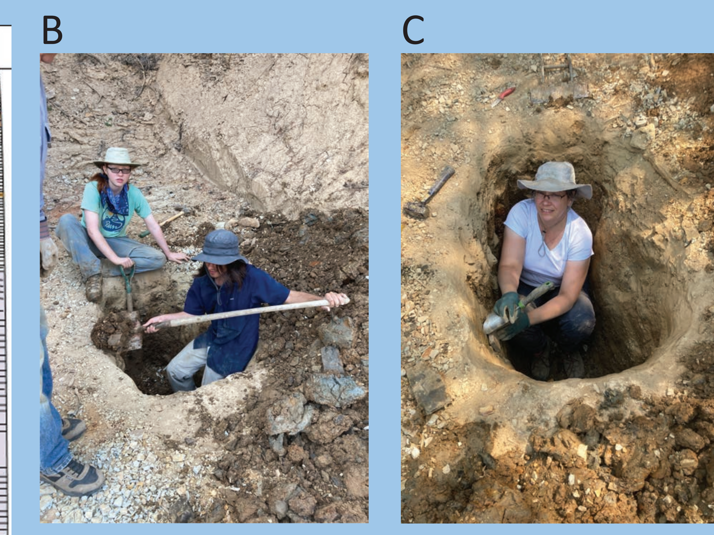
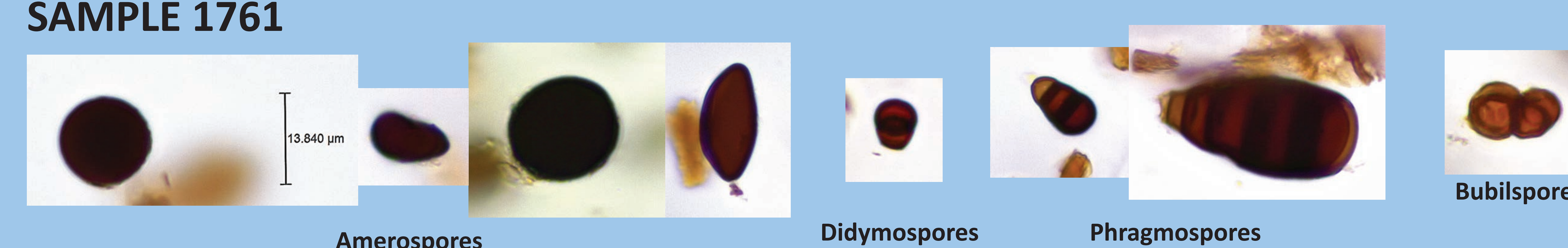


Figure 2. Stratigraphy and Exposure of the Study Section
Ash RA 3 is the third ash deposit from the top of the composite stratigraphic section from the upper Latah Formation "Clarkia" sections (a). It is exposed in the Pipis (2012) study section at P33, known as "Stefanie's Pit," which was re-excavated in July 2021 and re-sampled for study (b & c). This section consists lacustrine sediments underlying an airfall volcanic ash and re-worked ash material in overlying lacustrine sediments (a). Samples were obtained from the pit (d) and overlying lacustrine sediments (e). Stratigraphy adapted from Pipis (2012).

RESULTS

SAMPLE 1761



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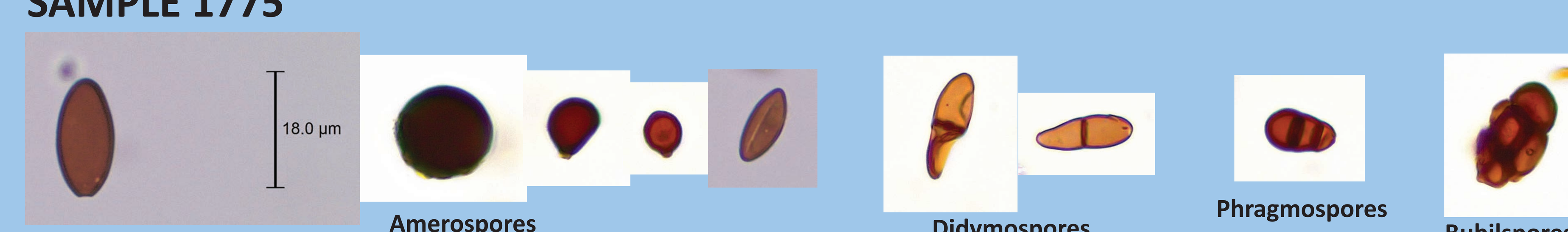
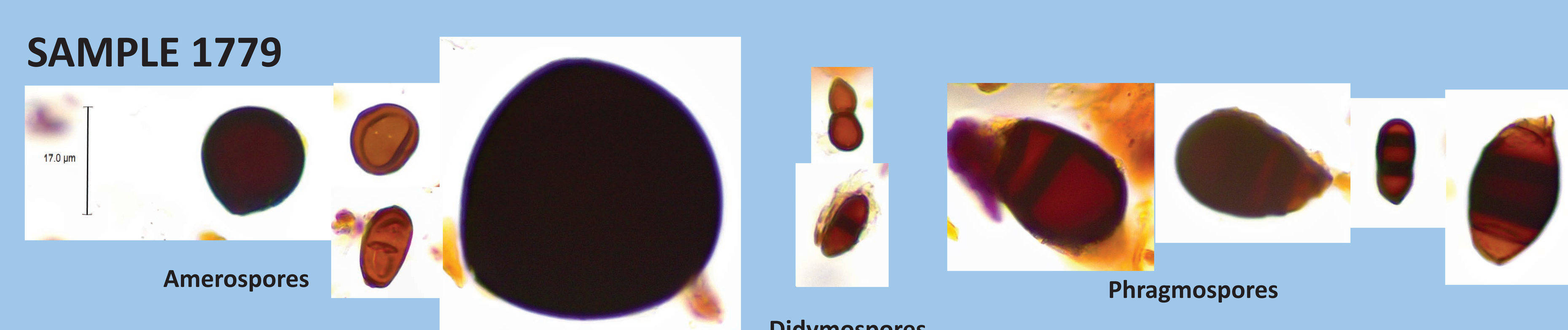


SAMPLE 1779



SAMPLE 1781

SAMPLE 1785

METHODS

The samples were processed using acid-free methods (O'Keefe and Eble (2012) as modified by Pound et al. (2021)). The residues were then mounted in PVA. A total of 13 samples were analyzed using brightfield microscopy at 1000x magnification on Leica DM750P microscopes with integral ICC50W cameras and Leica Application Suite® software. Images presented are z-stacked composites produced using Helicon Focus® software; this method makes fine details easier to interpret. Results from the first 5 analyzed samples are presented here, with the caveat that identifications using primary literature on extant fungi are still underway.

CONCLUSIONS

Although these results are very preliminary, the biodiversity captured by the first five samples is lower than expected. In the analyzed samples amerospores are both abundant and have high diversity. There is also a relative abundance of didymospores present along with a few simple phragmospores and bubilspores.

Future work includes documenting the fungal diversity in the remaining samples and identifying the fungal taxa present. These fossil fungal taxa will be correlated with extant fungal species in order to help create a database of fungal ecological and climatological tolerances for the upper Latah Formation. This database will be used by Northumbria University-based project members for paleoclimate and future climate modeling.

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