2019

# Variations of stomatal frequency in Taxodium and Metasequoia populations at the mid-Miocene Clarkia Lake deposits: Implications for atmospheric CO2 reconstruction

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# Variations of stomatal frequency in *Taxodium* and *Metasequoia* populations at the mid-Miocene Clarkia Lake deposits: Implications for atmospheric $CO_2$ reconstruction

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Stomatal frequency (such as stomatal index-SI and stomatal density-SD) has been widely used to reconstruct atmospheric $CO_2$ levels in geological history as it is one of the most reliable proxies of paleo-$CO_2$ that predate the oldest ice-core records. However, living plants show large variations on stomatal frequency within the same species, potentially generating large error margins for estimated paleo-$CO_2$ levels using limited fossil specimen(s). The extraordinarily well-preserved and abundant fossil leaves from the mid-Miocene (~15Ma) Clarkia Lake deposits in northern Idaho, the USA, allow us to test variations within a population of a fossil species and to compare that cross different contemporary species. Our preliminary results from the SD of 15 cuticular membranes of *Taxodium* revealed a range of variation leading to $CO_2$ levels of 345-445 parts per million (ppm). The SI of eight cuticular membranes of *Metasequoia* from the same fossiliferous layers reconstructed $CO_2$ levels of 290-345 ppm. These wide and discrepant ranges imply that randomly selected fossil leaves with limited sample numbers may give a large range of $CO_2$ reconstructions and different methods (such as SD or SI) and different plant taxa (such as *Taxodium* and *Metasequoia*) may result in different $CO_2$ results. A better understanding of stomatal frequency variations within populations and consistent sampling method will reduce errors in paleo-$CO_2$ reconstruction.