Paleo-CO_2 reconstruction based upon *Metasequoia* leaves: A comparison of different proxies using early Miocene fossils from Inner Mongolia

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Due to its long and abundant fossil records and evolutionary stasis, the genus *Metasequoia* Miki ex Hu & W.C. Cheng has been widely used in the study of paleoclimate, particularly for the reconstruciton of paleo-atmospheric CO_2 levels by the stomatal ratio (SR, mainly as SD-stomatal density and SI-stomatal index) method [1]. Recently, several other leaf-based CO_2 proxies have been developed based upon leaf $\delta^{13}C$ [2] or leaf gas exchange models [3]. Theoretical models predict that SR method usually underestimates CO_2 levels compared with mechanic models [4], but testing using field data is still limited.

Here, we test these methods using *Metasequoia* leaves from the early Miocene Hannuoba Formation located in Zhuozi County, Inner Mongolia, Northern China. These well preserved specimens allow us to obtain large pieces of both clean cuticular membranes and cleared leaf fragments to retrive all stomatal parameters as well as $\delta^{13}C$ signals necessary for the three methods. CO_2 concentrations reconstructed by SI, Schubert and Jahren Model, and Franks Model are ~302, 503, and 505 ppm respectively, confirming that SR method indeed provides much lower estimation even under improved statistical treatment [5]. New emperical data and further statistical analysis revealed possible explanations for this observed discrepencies.

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