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Detection, identification and clustering of palynomorphs using AI and machine learning

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Palynology is widely used in both academic and industrial research for correlation and interpretation of subsurface geology on both local and regional scales. While most data gathering tools for the subsurface have undergone major technological developments during the last decades, palynological research has, apart from the use of more advanced microscopes, remained virtually unchanged and can be quite time consuming when large data sets are required. With increasing demand for faster, more high resolution and more detailed palynological analyses from the continuously developing technological industry as well as the academic science community, palynology is at risk of being left behind.

The answer could lie in adopting strategies of digitalisation and Artificial Intelligence (AI) originally developed for medical research. The technology of scanning microscope slides into a digital high-resolution image has already been developed, and AI software specifically developed for palynology can be utilised to examine the digital images and detect, identify and quantify the fossil content.

In this project we have designed and developed an AI software for clustering and classification of microfossils based on deep-learning based algorithms for detection of palynomorphs and algorithms based on autoencoders for extracting features predictive of different fossil types. The AI is trained to recognize and identify fossils from different angles, preservation levels and fragmentation stages, as well as partially obscured or folded specimens. The AI can then analyse specimens for morphological parameters such as texture, shape and/or RGB/HSV values and use these parameters to categorize the specimen into clusters. The clustering has many applications, e.g., identifying morphological variations within taxa and recognizing variations in colour and preservation related to reworking or caving during the drilling process. The project also explores the advantages and disadvantages of working with digitally scanned palynological slides and the use of AI software recognition. The project will establish if the digital scans of the palynological samples have the resolution needed to be used for quantitative analyses and develop a preparation process to reliably produce the best digital samples possible.