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Thermal alteration of sedimentary organic matter in response to igneous intrusion (Karoo Basin, South Africa) and its implication for shale gas exploration

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Most approaches used to reconstruct thermal alteration of sediments require advanced, relatively expensive analytical techniques. Recently, alternative methods were tested [1], evaluating the application of a less costly, relatively simple approach of visually assessing palynomorph colours to determine thermal alteration.

Here, we introduce the phytoclast colour index to estimate thermal alteration in response to igneous intrusion within volcano-sedimentary basin settings. As study material, we selected terrestrial organic-rich siltstones and coals and marine black shales of the Karoo Basin intruded by dolerite sills and dykes. The investigated successions were recovered from coal exploration boreholes as well as from a research borehole drilled within the framework of the KARIN (Karoo Research Initiative) research programme.

We analysed all plant debris, including phytoclasts, wood remains and cuticles, to individually evaluate their thermal alteration signals. The thermal alteration estimates from all phytoclast groups yield a consistent picture corresponding to the vitrinite reflectance data from the same samples. They indicate that downhole and lateral thermal alteration do not increase until 20 m above/below the igneous sill and away from the igneous dyke, respectively. This signature is seen as an additional tool to evaluate the resource potential for shale gas in volcano-sedimentary basins and thus will serve to regionally plan future exploration, development and production of unconventional resources.

References:

[1] Pross J et al. (2007) Int J Coal Geol 70: 277-291