Effect of Contact Metamorphism on Coal Geochemistry and Petrology: Implications for the Release of ^{12}C-Enriched Methane

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Concern regarding the accelerated rate of carbon input to the atmosphere has prompted the search for comparable events throughout Earth's history. Recent research has attempted to determine the cause of such events, represented as δ^{13}C excursions within the sedimentary record. It has been suggested by other researchers that such excursions could be the result of the large-scale release of ^{12}C-enriched thermogenic methane produced by the intrusion of igneous rocks into organic-rich rocks. However, mass-balance calculations suggest that methane generated by such events would not significantly affect atmospheric carbon levels. Our study asserts that if these models are to be applied to large-scale releases of ^{13}C-depleted methane from intruded coals, ^{13}C-enriched coal should be observed adjacent to the intrusions.

Using examples of intruded coals from the Piceance, Illinois, and Karoo basins, we emphasize the importance of maceral content and rank at time of intrusion on the ultimate geochemical, petrographic, and isotopic composition of the heat-altered coals. Petrographically, intruded coals may show development of high reflectance, flow structure, mosaic structures, devolatilization vacuoles, carbonate mineralization, and pyrolytic carbon formation. However, no transects show any significant ^{13}C enrichment of the coal as the intrusion is approached, with shifts only on the order of 0.4 to slightly more than 1‰, hardly what might be expected if the intrusion had resulted in a significant release of ^{12}C-enriched gases. Some isotopic shifts (e.g., in the Karoo Basin) appear to reflect changes in petrographic composition more than any other factor.