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CRM-0016 and CRM-0017: New Certified Reference Materials for δ13C obtained from Organic-Rich Shales

EDUARDO MÜLLER BERNARDES SR.[1], ALEXANDRE RIBEIRO CARDOSO SR.[2], DÉBORA COELHO DE ANDRADE[1], FILIPE DE MEDEIROS ALBANO SR.[1], GABRIEL RUBENSAM SR.[1], GUSTAVO BOMBARDELI BARP SR.[1], JULIANA NICHELE KICH[1], NAIRA POERNER RODRIGUES[1], FELIPE DALLA VECCHIA SR.[1], ANDERSON JOSÉ MARASCHIN SR.[1] AND JOSELITO VAZQUEZ[3]

[1]PUCRS
[2]UNICAMP
[3]Petrobras

Two Certified Reference Materials (CRMs) for δ13C were developed from organic-rich Lontras shale (Pennsylvanian-Permian, Paraná Basin, Brazil), following ISO 17025 and ISO 17034 standards. Isotopic analysis was performed using an elemental analyzer isotope ratio mass spectrometry (EA-IRMS) for total carbon (TC) and isolated total organic carbon (TOC). TOC measurements were independently verified using CHNS/O and RockEval 7, showing excellent correlation (r = 0.99). Homogeneity and stability tests confirmed the CRMs' reliability, with 10 vials tested for homogeneity and 3 vials analyzed monthly for stability. ANOVA and Grubbs tests detected no significant outliers. The CRMs displayed high organic content, with TOC ranging from 4.30 ± 0.04% to 12.05 ± 0.07%. Petrographic observations confirmed the organic matter as dominantly isotopically organic, with no carbonate interference. δ13CVPDB values for stratigraphic levels 1–3 were − 26.76 ± 0.14‰ (CRM0016), while level 4 yielded − 24.39 ± 0.13‰ (CRM0017). Both CRMs showed normalized errors < |1.0| between TC and TOC methods, confirming metrological equivalence. Homogeneity tests ($P > 0.05$) verified that samples from levels 1–3 could form a single CRM (CRM0016). Expanded uncertainties were calculated at a 95% confidence level (k = 2), with repeatability (CV%) below 0.5%. Post-production monitoring ensures CRM quality for up to two years. These CRMs are the first isotopic reference materials derived from Brazilian sedimentary basins and are intended for calibration, validation of analytical methods, and quality control in isotopic carbon measurements of organic carbon-bearing materials.