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Geochemical evidence for dissolved methane enrichment associated with surface sediment resuspension on the Korean continental shelf

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Bottom-water dissolved methane (CH_4) on the Korean continental shelf reached up to 16.7 nM during intensified near-bed currents (~10 cm s^{-1}) and exhibited $\delta^{13}C$-CH_4 values of −56.8 to −55.3‰, indicating a dominantly biogenic source modified by partial oxidation. To constrain the processes driving these short-lived CH_4 anomalies, we conducted a 2-day seafloor monitoring experiment in August 2017. The monitoring system continuously recorded bottom currents, salinity, temperature, depth, and seafloor video imagery, while bottom-water samples were collected at ~1 h intervals to quantify temporal variability in dissolved CH_4 and $\delta^{13}C$-CH_4. Additional CTD-rosette observations at a nearby site provided vertical profiles of dissolved CH_4 concentrations and $\delta^{13}C$-CH_4 to assess water-column structure and spatial variability. Time-series observations reveal distinct CH_4 maxima coincident with elevated bottom currents, consistent with episodic disturbance of surface sediments overlying gas-charged layers. Excluding the peak value of 16.7 nM, dissolved CH_4 concentrations in 47 bottom-water samples ranged from 0.20 to 7.49 nM. CTD-rosette data show that at depths at depths greater than 8 m, $\delta^{13}C$-CH_4 values (−56.9 to −55.1‰) closely matched bottom waters, whereas shallower than 5 m, values were systematic enrichment (−52.6 to −51.2‰). These coupled concentration–isotope patterns demonstrate that transient sediment resuspension can rapidly increase dissolved CH_4 in the water column even under fair-weather conditions. The study area is directly and indirectly influenced by typhoons during summer and autumn, suggesting that stronger and more frequent disturbances may further amplify methane mobilization on the shelf. Our results highlight episodic shelf methane release as a climate-relevant process and underscore $\delta^{13}C$-CH_4 as a sensitive tracer for distinguishing resuspension-derived methane from background signals.