Supplementary Information

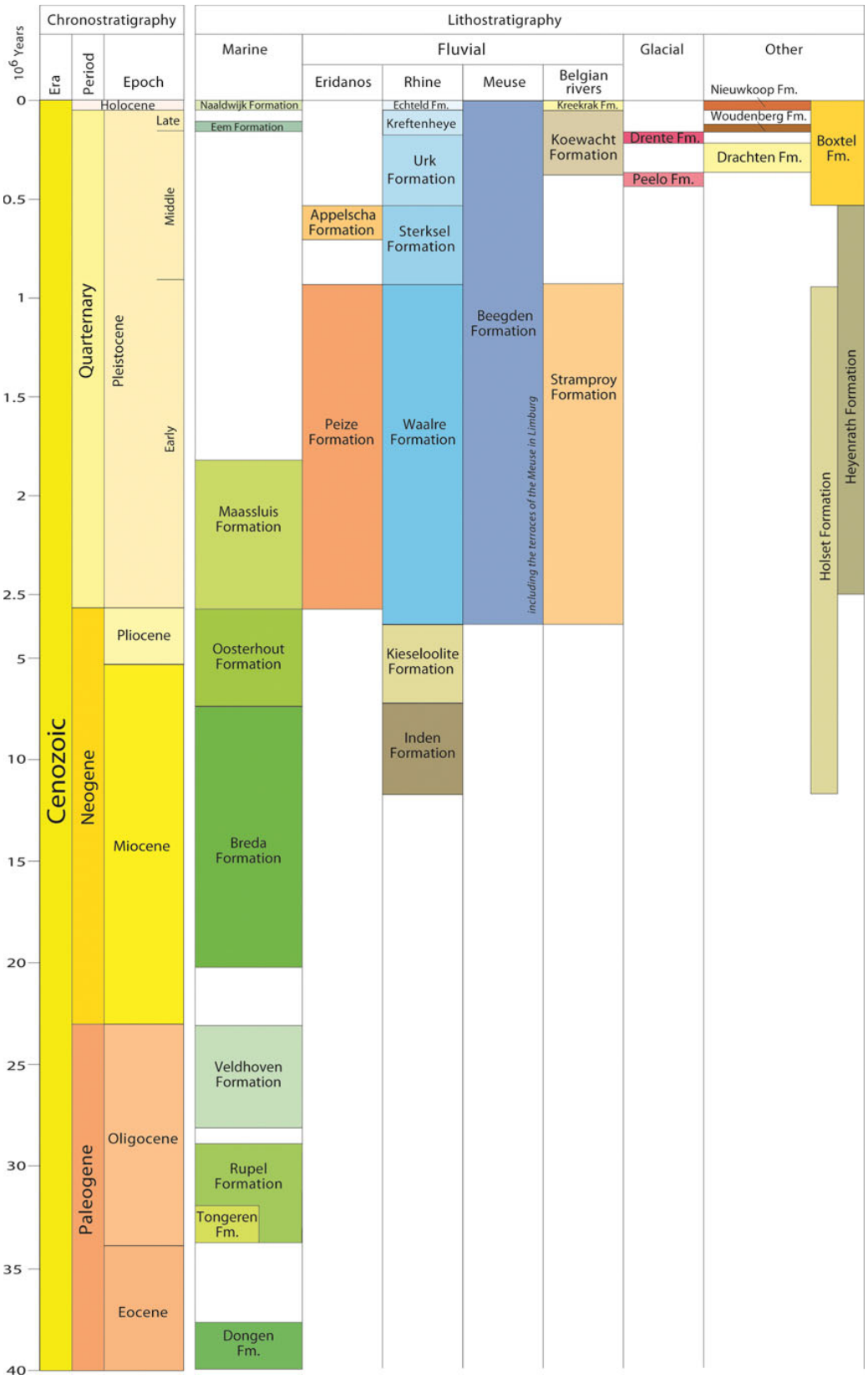

Fig. S1. Lithostratigraphy of Cenozoic deposits in the Netherlands. Taken from J. Griffioen et al., 2016.

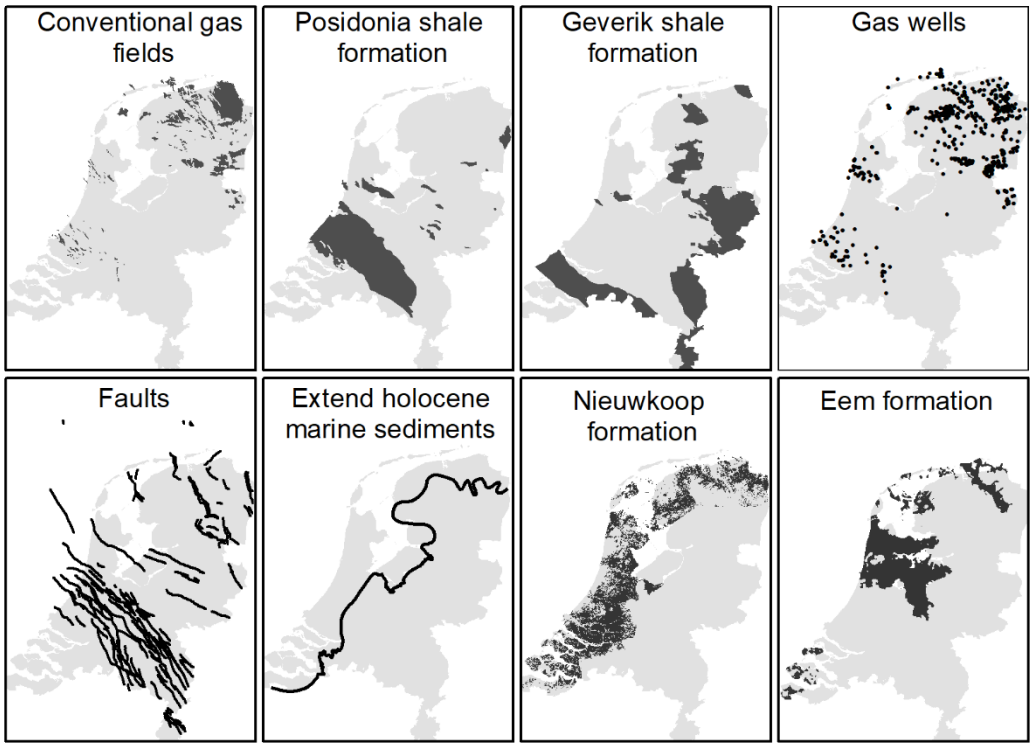

Fig. S2. Spatial features used for the statistical analysis of methane concentrations described in section 4.1.4. Surface area of conventional reservoirs, shale formations and gas wells obtained from the Netherland Oil and Gas Portal (www.NLOG.nl). Surface area of Nieuwkoop Formation, Eem Formation, and location of faults obtained from the Geological Survey of the Netherlands (www.dinoloket.nl). Extent of Holocene marine sediments derived from Griffioen et al. (2013), and area west and north of the line is referred to as the coastal lowlands.

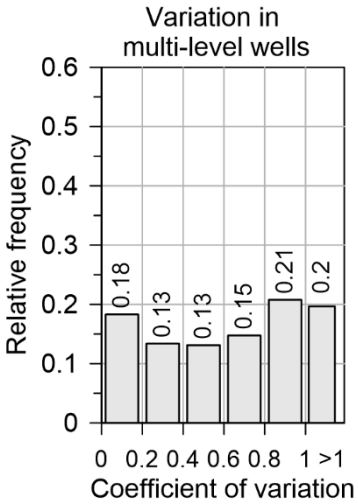

Fig. S3. Relative frequency histogram of the within well coefficient of variation (CV) of methane concentrations in multi-level monitoring wells with at least multiple sampled well screens. Only well screens with average methane concentrations > 0.01 $mg.L^{-1}$ were considered.

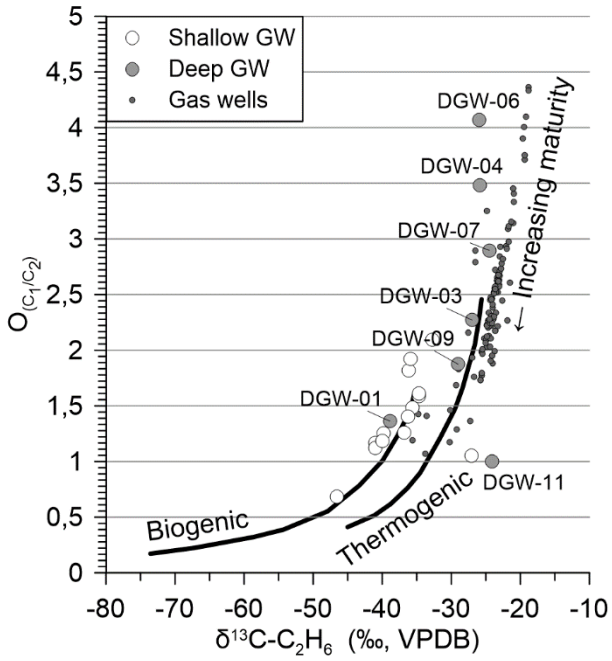

Fig. S4. Ethane carbon isotope ratio versus the isotope factor $O_{(C1/C2)}$ for Dutch shallow groundwater, deep groundwater, and natural gas accumulations. Definition of the $O_{(C1/C2)}$ parameter and black lines indicating the regions with biogenic and thermogenic methane based on Cesar et al. (2021).

Table S1. Gas composition from onshore deep wells in the Netherlands tested in Paleogene or younger formations. Data from (NLOG, 2020).

Well ID	Formation	CH_4 (mol%)	C_2H_6 (mol%)	C_3H_8 (mol%)	CO_2 (mol%)	N_2 (mol%)	C_1/ [C_2+C_3]
WYK-01	Basal Dongen Tuffite	88.63	0.19	0.02	0	11.15	522
WAV-09	Basal Dongen Tuffite	89.09	0.14	0.01	0.01	10.75	594
IJS-01	Basal Dongen Tuffite	96.5	0.04	0.01	0.1	3.3	1930