Factors influencing the natural leakage of gas

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Résumé

Today, natural gas emissions from geological sources represent only a small part of greenhouse gas budgets but understanding the context in which these occur may help evaluate risks of leakage from geological storage. For this purpose, we cross examine global CH4 and CO2 geological emission data sets and global maps defining their geological context: presence of a sedimentary basin, its age and tectonic context, strain rate, stress regime, seismic activity, heat flow, nature and origin of the gas. Natural leakage of CO2 is primarily reported in association with volcanism while natural leakage of CH4 is more often reported in sedimentary basins, but this merely reflects the distribution of gas sources. However, the geomechanical conditions that control leakage may be in large part independent of the nature of the gas. For instance, distributions of natural CO2 and CH4 leakages and a gridded estimation of methane fluxes (Etiope et al., 2019) correlate with the global strain rate map of Kreemer et al. (2014). The probability of leakage, or the areal flux, is lower in plate interiors than along plate boundary zones and displays a progressive increase by a factor of 20 to 80 with strain rate, up to 10-7 y-1. Deformation style also influences leakages as strike-slip environments are favored over pure (vertical plane strain) compression and extension. Moreover, a disproportionate fraction of leaks occurs in rare zones of multidirectional extension (spreading) and compression (convergence). The role of fault interactions, and specifically of geometrical incompatibilities, in causing vertical leaks is a possible explanation.

Réferences

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