[PS]Parallel Salt and Methane Generation, Possible Paradigm Shifts for Salt Generation in Deep Sea Processes*

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Abstract

Until today, salt generation has been attributed to residual seawater evaporation. The newly discovered processes of parallel salt and methane generation suggests that this may not be the only possible hypothesis. This second hypothesis becomes interesting considering that many salt basins overlap with some of the gas provinces, suggesting that salt structures, stratigraphy and diapir generation will create a framework for HC systems. Existing deep marine hypersaline anoxic basins (DHAB) in the Mediterranean Sea are well-documented. This region provides an analogy between the current and ancient DHABs, which allows us to hypothesize that salt basin methane deposits have been generated by euryhaline bacteria. This redefines the relationship between salt and methane deposits. Our hypothesis presumes that a secondary mechanism of salt generation takes place on a geological scale. Beginning with the idea that sea water is a neglected colloid system, we intend to show that intensive hypersaline brine generation has been taking place today and in the past. The mechanism of brine formation consists of well known, common processes that proceed in a well-defined order; and these can be presumed to be accountable for the parallel generation of salt and methane.

We hypothesize that the flocculation of argillaceous particles in a deep marine environment creates a semi-permeable membrane whose polarization initiates the process of DHAB formation. The reverse osmosis process concentrates the common ions (NaCl) under this surface where an intense bacterial mat generates methane. We further postulate that the non-crystalized, over-pressured, salty brine is the appropriate material to trap and host methane. This viscous, gas-saturated brine supporting the covering sediments can be deeply buried and thus become an engine for diapir formation. When the overburden is breached, the upward movement of hypersaline brine simultaneously crystalizes salt and releases methane and water. This concept will require further research and consideration as an alternative for parallel salt and methane generation, coupled with salt diapir formation in particular salt basins. As a possible example, we plan to research whether the 250 m thick salt layers in the Transylvanian Basin (Romania) arose from millions of years of inundation and evaporation or could have been generated by buried, over-pressured salt brine crystallizing during diapir generation along the extensional structural elements.

PARALLEL SALT and METHANE GENERATION

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Not all salts can be considered evaporites

DISCUSSION

1. Why does **diffusion** not work **?**

2. How is that **surface** formed**?**

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3. Can this phenomenon occur over **geological timescales?**

Conductivity

40 60 80 100 120 130 *[mS/cm]*

Salinity

40 60 80 100 120 140 *[ppt]*

[m] 250 500 750 1000 1250 1500 1750 2000 2250 2500 2750 3000 3250 3500 3636 3637 3637.5 3638 3638.5

HISTORY

Wielicka Salt Mine (Poland)

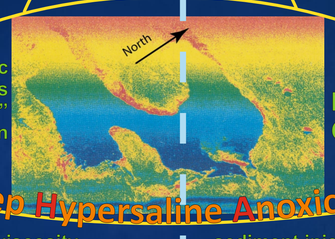
methane burners

Historic inspiration and background

the first recorded firedamp explosion occurred on 9 September 1664 in Hallstatt Salt Mine (Austria) [1]

EVIDENCE

the sonic response is "flat" reflection



MEDRIFF Consort. [2]

Deep Hypersaline Anoxic Basins

high viscosity

sediment injections

surface tension *(sea water and salt brine layers)*

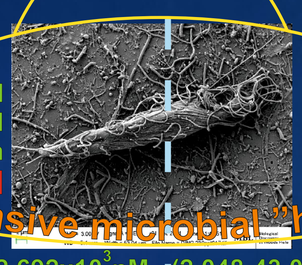
similar brine accumulation was found

Brine physical properties [3]:

Parameters	Brine L1 2 940m	Brine L2 2 975m	Brine L3 3 010m	Brine L4 3 102m
Density [kg/dm^3]	1,19	1,21	1,22	1,22
Salinity [*mmol/kg*]	304	314	325	345
CH_4 [*µmol/L*]	18.0 ± 3.1	70.3 ± 2.3	24.1 ± 3.3	13.9 ± 1.4
Acetate [*µmol/L*]	132 ± 21	532 ± 42	508 ± 37	n.d.
MPR [*µmol/L/day*]	2.1 ± 0.2	3.1 ± 0.4	1.5 ± 0.6	0.5 ± 0.4
Glycerine Betaine [*nmol/kg*]	170 ± 9	n.d.	44 ± 7	n.d.

Brine biological characteristics:

stratified bacterial ecosystem [4]



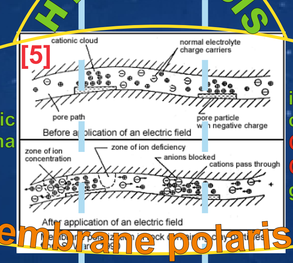
CH_4 intensive microbial "hot-spot"

128-2,692x10^3 nM (2.048-43.072 mg/L)

methanogenesis in brines

HYPOTHESIS

electro-kinetic phenomena



in the colloids the Critical Micella Concentration (CMC) generates

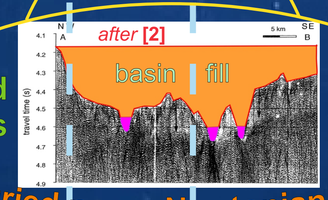
membrane polarisation

the potential field of Ca^{2+} and Mg^{2+} increase conductivity causing

coagulation and flocculation

This polarisation will serve as a reverse osmotic semipermeable membrane; the ion concentration behind increases, reaching high salinity and viscosity. The surface tension preserves the membrane while the diffusion is blocked.

buried brines

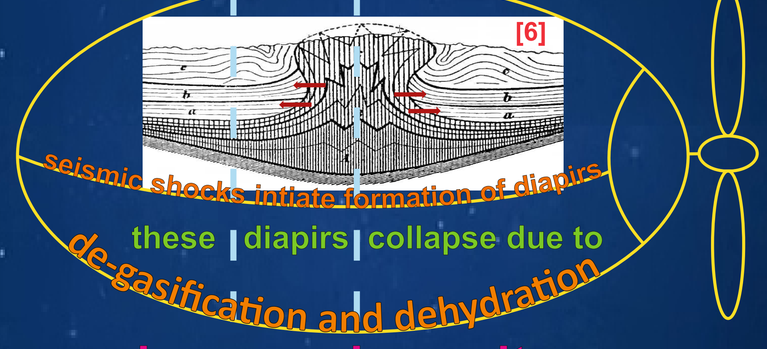


support sediments

buried non - Newtonian fluid

In our view, this can also happen in geological timescale

overpressured and oversaturated



seismic shocks initiate formation of diapirs

these diapirs collapse due to de-gasification and dehydration

deep marine salt and subsequently diapirs are formed by crystalisation

acetate decomposes:

$$CH_3–COOH = CH_4 + CO_2$$

Methane content of the DHAB:

primary bacterial generation: 40 mg/l

secondary acetate decomposition: 30mg/l } **~70 mg/l**

THESE BRINES HOLD METHANE RESOURCES

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OIL&GAS DEVELOPMENT

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