CRITICAL RESEARCH PARAMETERS AMONG HALOKINETIC PROCESSES ORGANIZING THE CILICIAN SALT-SEDIMENT SYSTEM, THE NORTHEASTERN MEDITERRANEAN

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Abstract

The dynamic evolution of the Cilician-Adana salt-sediment system and structural development is affected by salt tectonism and halokinetic regimes. Gravitationally unstable and asymmetric uneven overloading of frictional-plastic delta sediment progradation (Plio-Quaternary) above a viscous salt substrate (Upper Messinian salt) in the basin resulted in halokinesis and delta progradation-controlled prominent structures. Analyzing and parameterization of salt dynamics such as regional destabilization of salt, upward mass transport, dissolution, mobilization, migration, withdrawing, evacuation of salt, emplacement mechanisms of diapir growth, delta deformation pattern in the basin, and the resultant architecture of salt-sediment body styles are vital to understanding the history of salt structure formation, its geodynamic effects on structural evolution of the basin. Some quantifications of the dynamics controlling viscous-plastic regime of salt at the Cilicia back-arc region improved seismic data interpretations on basin analysis, and lead to critical research parameters among halokinetic processes.

Keywords : Diapirs, Evaporites, Messinian, Seismics.

The dynamics of salt tectonics in the Cilicia-Adana Basin has been recently investigated using seismic reflection profiling of a viscous substrate underlying a frictional-plastic sedimentary overburden of laterally varying thickness by ([1], [2]), geologically by [3]and seismic stratigraphically by [4]. Seismic reflection data collected by Graham Evans during the years of 1974-1977 and briefly reported by [2] illustrated a wide range of halokinetic structures and their evolutionary stages such as salt pillows and diapirs, salt dissolution structures, collapse-solution depressions, rim synclines, peripheral sinks, mini depocenters, secondary basins driven by salt-related thin-skinned tectonic processes.

The Cilicia Basin is tectonically unstable, due to halokinesis, back-arc sedimentary region with considerable evaporite deposits, and hence, dynamic modeling of delta sedimentation above a viscous salt layer in the basin consists of critical research parameters. Clues to the regime of halokinetic processes are found in these measurable parameters of the Cilicia basin. Based on a critical appraisal of the seismic survey and dynamic geology of salt systems, some parameters are also estimated for each of modern salt tectonic zones in the world. This work represents only a small part of research concept within salt-sediment dynamics and indicates the next investigations of margin tilting, basement and salt layer geometry, sediment-salt rheology, the hydrostatic pressure in the submarine environment, localized stress-strain fields, fluid overpressure within the sediments, isostatic effects, thermo-mechanical structure, low density mass transport, subsequent convectional properties of diapirism and evaporates. The conceptual and observational basics of all these important parameters can effectively influence the stability of regional halokinetic regime, delta overburden deformation, thus organizing a complete framework of salt-sediment system dynamics in the basin as follows;

Geomechanical Analysis; basement geometry and basal slope, the Plio-Quaternary delta overburden and upper Messinian salt layer geometry, salt withdrawal compensation (SWC), salt-sediment overburden rheology (friction, cohesion, strain softening etc.,).
Sedimentation and Sediment Physics; compensatory sediment loading (CSL), differential sediment thickness, delta progradation and its deformational effect on salt-sediment body architecture, the velocity and input ratios of episodic sedimentation, mini-depocenters, and physical properties of sediments.
Chronization and Distortion in Folding Styles; syn-/diachronized folding of salt-sediment body styles and time relationships between sediment influx and the main salt stock (mother salt) as feed back process.
Thermo-mechanical and Hydrological factors; thermal evolution of halokinetic structures, salt-pore water convectional process, deformation-fluid flow interaction, salt upwelling rates (low density mass transport), salt dissolution-karstification and correlative basin dating with other salt basins and hydrocarbon maturation.
Buoyancy Factor and Deformation Styles; brittle or viscous deformation of buoyant diapirs (the controversial problem of buoyant salt diapirism), viscosity contrast, differential stresses (stress state-strain rates), and creeping or faulting. Buoyancy levels (positive, negative, neutral) of diapirs, subsurface erosion and removing of topographic relief induced by diapir swells.
Abnormal Pore Water Pressure; pore water overpressure fluctuations both in salt deposits and also sediments, spatial and temporal variations in fluid overpressures, the strong effect of diapirism as pressure seals (or trap/confinement mechanism) on basinal stress, strain and strength relations and local mapping of differential high strain fields in the basin.
Hydrodynamics; high density-salinity brine pools on the sea bottom and their residence, indicating deep water current system and saline conditions (stagnant or unstagnant).
Regional Tectonism; superimposed and contrasting regimes of thin and thick-skinned tectonism. *Isostasy;* flexural isostatic compensation (e.g., Adana flexural delta platform system), and rapid graben subsidence as a regional response to extensional block faulting or vertical differential movements in the basin. *Eustasy;* effects on delta sequence stratigraphy, facies analysis and tectono-/sedimento-eustatic relations between fluctuating sea level and upward diapir growth-lateral salt flow.

As petroleum exploration becomes increasingly focused on the Mediterranean deepwater evaporite basins, insight into these parameters driving salt-sediment dynamics will be useful in constraining the timing of salt development and also the implications this has for overburden deformation, salt-sediment distribution patterns and hydrocarbon maturation.

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