Thermodynamic and molecular approaches to physical-chemical evolution of high-temperature volatiles

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There are two parts of common physics having common aims and tasks, but very different in methods of researches – thermodynamics and molecular physics. Thermodynamics operates with empirical data (macrofunctions and macroconditions) and ignores the gist of processes on molecular level. Contrariwise molecular physics analyses the gist of processes on molecular level, but has difficulties with processing of complex macrosystems. If systems macroparameters are known, thermodynamics guarantees precise quantitative estimations for macroreactions and macroprocesses in system. Molecular physics discovers qualitative gist of molecular processes in system. So thermodynamics and molecular physics must be used together if we want to understand the gist of natural processes. However scientific mainstream is thermodynamics methods in geosciences now, molecular physics is not used. It isn't correct. In endogenous geology the sense of quantitative thermodynamical methods decreases according to increasing of the number of parameters having unknown values. Molecular physics may be very useful in this case, as its methods well describe the gist of some endogenous processes (for example, physical-chemical evolution of high-temperature volatiles, genesis of oil and ore deposits).

The liquid–gas phase transitions play an important role in the evolution of endogenous fluids. When high-temperature gas mixture cools and reaches the critical temperature for one of components, it separates to form a gas–liquid interface. These processes lead to the formation of a high-temperature condensate, which accumulates excess components with the highest critical temperature. Based on elementary molecular-chemical concepts, we can trace possible evolution of gas phase of endogenous fluids and distinguish three geochemical fields of practical importance, which are listed below (from higher to lower temperature fields). (1) Zone of sulfur condensation is of great significance for the formation of many ore deposits and the formation of endogenous native sulfur deposits in zones adjacent to the water neutralization barrier. (2) Water condensation zones serve as a fluid neutralization barrier, where acid fluid flows originate. This zone has a key significance for the formation of hydrothermal, gold ore, and quartz deposits. (3) Zone of H2S and CO2 condensation plays a leading role in the endogenous formation of hydrocarbon deposits.