Planetesimal gravitational collapse in gaseous environment: thermal and dynamic evolution

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One of the main unknowns in planet formation concerns the formation of planetesimals from pebble-size grains. Generally, models invoke a gravitational collapse of pebble clouds to overcome the various barriers to grain growth and propose processes to concentrate particles sufficiently to trigger collapse. At the same time, geochemical approach constrains the conditions for planetesimal formation and evolution by providing temperatures that should be reached to explain their final composition. In particular, the origin of noble gases in the terrestrial mantle is still debated and might ultimately provide a unique clue on this stage of planet formation. To elucidate the thermal evolution during gravitational collapse of the pebble cloud, we run numerical simulations of a self-gravitating cloud of particles and gas coupled by gas drag. We aim at determining how the gravitational energy relaxed during the contraction is distributed among the different energy components of the system, and how this constrains the thermal and dynamical planetesimals history. We characterise the conditions required to achieve a temperature rise of up to 1000K. Our results emphasise the key role of the gas during the collapse.