The first minutes of cooling of a lava flow are investigated assuming that the lava rheology is pseudoplastic and dependent on temperature. The lava flows down a slope under the effect of the gravity force inside a channel of rectangular cross section. At its surface, lava cools for thermal radiation.

First, we considered the cooling due to heat conduction from the surface to the lava interior. Results indicate that velocity profiles rapidly deviate from that of an open lava channel to that of a crust covered lava channel, where the chilled lava surface travels with a speed that is very low in respect to the speed of the hot lava interior.

Then, we investigated the role of the advection in the heat equation. In this case the dynamic and the thermal equations are mutually coupled. Results indicate that the advective heat transport acts as a source of heat and modifies the cooling rate of the lava surface slowing down the cooling process. The lava velocity inside the channel and on the channel surface is modified by the heat advection and the chilling of the lava surface is delayed. The lava velocity affects in turn the temperature, which at the channel levees, where the velocity is null, decreases more rapidly than at the centre of the channel, where the velocity is maximum. Both the conduction and the advection conduction heat equations are solved numerically, through the finite volume method. Results agree with observations of active lava flows.