

# Grain processing along the evolution of shocks in L1448–mm/IRS3

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## Abstract.

The presence of shock activity in star–forming regions is known to drastically change the chemistry observed toward these regions due to the ejection of material from grains (see e.g. Hartquist et al. 1980; Martín–Pintado et al. 1992). Evolved bipolar outflows like L1157–mm ( $t_{dyn} \geq 10^4$  yr; Bachiller & Pérez–Gutiérrez 1997) show a very rich chemistry in molecular species like SiO, CH<sub>3</sub>OH, H<sub>2</sub>CO, H<sub>2</sub>S or OCS (abundances of  $\sim 10^{-7}$ ). It has been recently shown that the L1448–mm outflow ( $t_{dyn} \sim 3500$  yr) presents a particular chemistry, specially, in sulfur–bearing molecules (Jiménez–Serra et al. 2005). Chemistry models with injection of material from grains show that molecular abundances typically evolve in time–scales of few  $10^3$  yr (Charnley et al. 1992; Charnley 1997; Flower et al. 1996). Since the dynamical age of L1448–mm is similar to the chemical time–scales, this outflow constitutes an excellent laboratory to establish the time–evolution of the abundances of key molecules in grain chemistry. In this poster, observations toward several positions along the L1448–mm/IRS3 outflows of CO, HCN, HNC, H<sub>2</sub>S, H<sub>2</sub>CS, SO, CS, OCS, SO<sub>2</sub>, SiO, CH<sub>3</sub>OH and H<sub>2</sub>CO, are presented. We distinguish between four groups of species depending on their characteristic shock–velocity regime: molecules with high–velocity emission (SiO, CO, HCO<sup>+</sup>, HCN and SO), molecules with intermediate–moderate velocity emission (CH<sub>3</sub>OH, H<sub>2</sub>CO and CS), molecules with ambient emission (HNC, H<sub>2</sub>S and H<sub>2</sub>CS), and undetected molecules (OCS and SO<sub>2</sub>). SiO is the most abundant species in the high–velocity regime since its abundance is enhanced by up to five orders of magnitude with respect to the quiescent gas, while the rest of high–velocity emission molecules are enhanced only by one order of magnitude. Surprisingly, CH<sub>3</sub>OH and H<sub>2</sub>CO, expected to have similar line profiles to SiO, show moderate velocity wings with terminal velocities of just  $\sim \pm 20$  km s<sup>–1</sup>. The lack of CH<sub>3</sub>OH and H<sub>2</sub>CO high–velocity emission is consistent with the idea that grains are progressively processed, from the first stage of icy mantle removal to the final grain core destruction, as the shock speed increases. This allows us to estimate the fraction of the grain mantles and cores that is injected into gas phase as a function of shock speed and, therefore, of time.

**Keywords:** astrochemistry – stars: formation – ISM: jets and outflows

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