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L183 (L134N), DUST, GAS AND DEPLETION

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Abstract. L183, also known as L134N is a well-known starless, dark cloud. Recent observations ranging from NIR to mm allow for the first time to fully map the dust content of the cloud. Dust temperature as low as 7.5 K in the core is advocated as well as strong molecular depletion. The CO depletion factor reaches at least 35 in the core and even N-bearing species like N2D+ and NH2D are depleted in the inner core. Finally, the core shows a density gradient proportional to 1/r which is the first such case today though such profiles (called logotropic) have been proposed by McLaughlin & Pudritz (1996, 1997). This cloud harbours one of the coldest cores with one of the largest depletions reported thus far.

1 Introduction

20 years ago, L183 has been recognized as a chemical standard for astrochemical models along with TMC 1. Several studies of the source have been dedicated to the mapping and measurement of many species to help test these chemical models (Swade 1989a, 1989b, Dickens et al. 2000 for the most important ones). However these studies have lacked two important features which limit the accuracy of their abundance estimates, namely the knowledge of the dust content and its influence on the gas composition and a proper radiative transfer model to adequately reproduce the main features of the emission lines. Both studies are thus flawn with

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the ignorance of the large depletion effect which prevails in this source and with the underestimate of the $C^{18}O$ opacity and therefore of its abundance. Progress in the mm and submm detectors in the 90's has allowed to map and measure cold (7–13 K) dust in dark clouds and find the prestellar cores. The long predicted and sought $C^{18}O$ depletion was therefore identified and chemical models have engaged in a major revolution by including these effects along with a more developed grain surface chemistry. A spectacular consequence of all this is the detection and modeling of very high deuteration ratios, reaching in somes cases 50% of the parent species and/or showing sizeable abundances of multiply deuterated species (for N_2H^+, CH_3OH, H_2CO, NH_3,...).

We have thus started a long effort to study the physical characteristics of L183 to better estimate its density structure and to better analyze the excitation of a few species (CO, CS, SO and N_2H^+). In parallel, we have also engaged a study of the dust content which is a difficult task in such a large cloud, in both emission and absorption. Several preliminary results have been presented in other conferences (Pagani et al. 2002, 2003a) and two papers have already been published (Pagani et al. 2003b, 2003c).

We show here a set of self-explained figures to illustrate some of our findings.

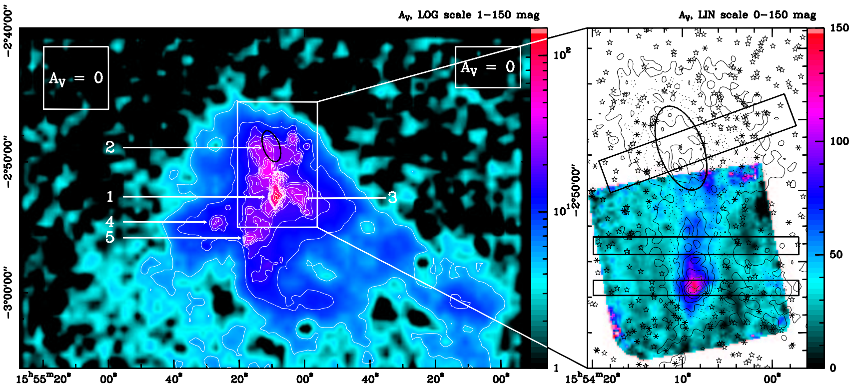

Fig. 1. Visual extinction map of L183. Levels are A_V = 5 to 50 by 5 (black contours) and 60 to 120 by 30 (white contours) mag. The enlargement shows the ISOCAM extinction image with MAMBO 1.2mm emission contours (contours from 7 to 22 by 2.5 MJy/sr). The 9.5 MJy/sr contour is dotted. 5 branches stars are detected in both H & K' while 6 branches stars only in K'. The ellipse has no actual extinction measurements (no stars seen in H inside). The lower visual extinction limit is 40 mag. The numbers indicate the peaks which have a molecular counterpart. The lowest of the 3 strips in the zoom image displays the radial cut modelled in Fig.3

References

Dickens, J.E., Irvine, W.M., Snell, R.L., et al., 2000, ApJ, 542, 870
McLaughlin D.E. & Pudritz R.E., 1996, ApJ 469, 194

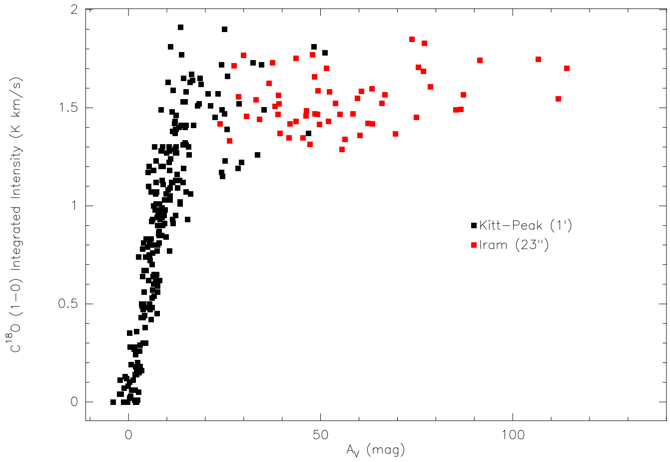

Fig. 2. $C^{18}O$ depletion. Large scale (Kitt Peak 12-m) and small-scale (Iram 30-m) maps have been reprojected on the dust map. $C^{18}O$ depletion is clearly visible and reaches at least 35 for the largest extinction values.

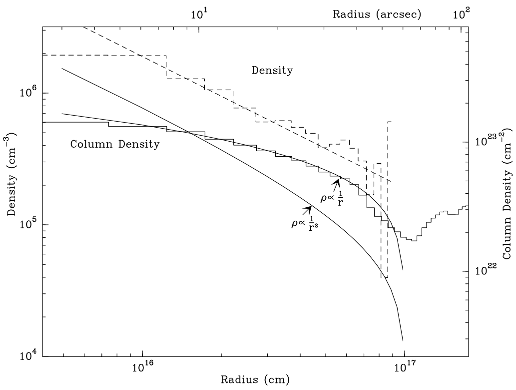

Fig. 3. Radial profile of the main dust core. The best fit is a r^{-1} density law (and a logotropic column density profile)

McLaughlin D.E. & Pudritz R.E., 1997, ApJ 476, 750

Pagani L., Pardo, J.R., Fich, M., Motte, F., Stepnick, B., 2002, in Infrared and Submm Space Astronomy, EAS Series, vol.4, EDP Publ., 145

Pagani L., Pardo, J.R., Cambrésy, L. et al., 2003a, in Chemistry as a Diagnostic of Star Formation, ed. C.L. Curry & M. FIch, in press

Pagani, L., Lagache, G., Bacmann, A., et al., 2003b, A&A, 406, L59

Pagani, L., Bacmann, A., Motte, F., et al., 2003c, A&A, in press

Swade, D.A., 1989a, ApJS, 71, 219

Swade, D.A., 1989b, ApJ, 345, 828

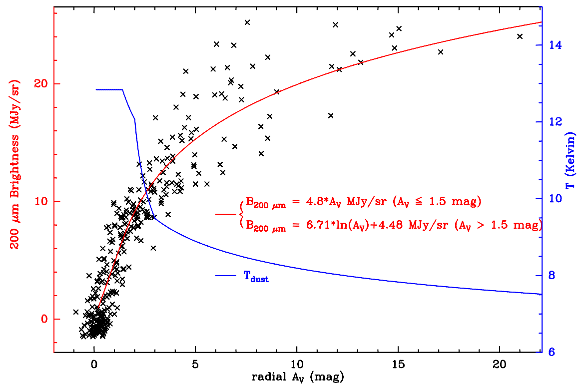

Fig. 4. The dust extinction has been correlated to the ISOPHOT 200 μm emission after convolution to the same 1.5′ resolution. The 200 μm does not trace dust beyond 7.5 mag of radial extinction (15 mag total). The best explanation is that the dust becomes too cold deep inside the cloud to emit significantly at 200 μm

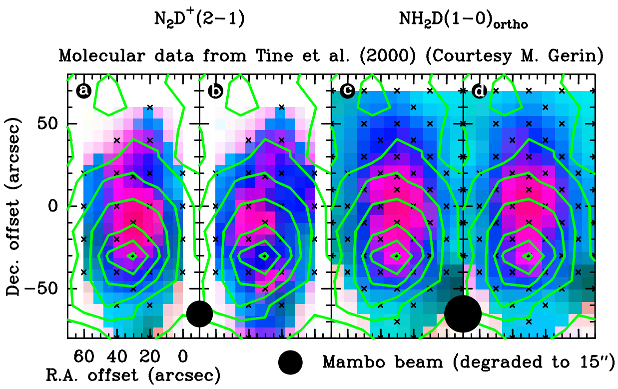

Fig. 5. Even N-bearing molecules eventually deplete in the deep interior of the dust peak. The dust emission at 1.2 mm in green contours is 20–30″ south of the molecular peak. Integrated intensity maps of N_2D^+ (J:2–1), **(a)** main hyperfine component, and **b** satellite components and of NH_2D ($J_{KK'}$: $1_{1,1}$–$1_{0,1}$), **c** main hyperfine component, and **d** satellite components. The dust core is in grey contours. Map offsets are relative to 15h54m06.6s, −2°52'19.1" (J2000). Levels : **(a)** 0.1 to 0.6 by 0.1 K km s^{-1}, **(b)** 0.1 to 0.6 by 0.1 K km s^{-1}, **(c)** 0.1 to 0.6 by 0.1 K km s^{-1}, **(d)** 0.1 to 0.6 by 0.1 K km s^{-1}. MAMBO data : 20 to 80 by 10 mJy per beam, 15″ sampling. Beam sizes for each line is given for each pair of boxes and the MAMBO beam is given below