ABSTRACT

We present here a preliminary analysis of a chemical survey of selected lines between 86 and 115 GHz, of 15 sources identified in the 1.2 mm dust continuum emission from the molecular cloud associated with the southern star forming region RCW 106.

Key words: RCW 106; Millimeter sources; 86-115 GHz Spectroscopy.

1. OBSERVATIONS

We have chosen the 15 brightest sources detected in the 1.2 mm dust continuum emission from the molecular cloud associated with the southern HII region RCW 106. The 1.2 mm dust continuum map (see Fig 1) was observed by Mookerjea et al. (2004, A&A, 426, 119) using SIMBA on SEST and extends over a region of 28(pc^9)4pc. We have observed transitions of CO, C^{18}O, CS, C^{34}S, HCN, HNC, HCO^+, H^{13}CO^+, N_2H^+ and the 2_1 -> 1_1 quartet of CH_3OH lying between 86 and 115 GHz. The observations were done using the 22m MOPRA radio telescope operated by the ATNF, Australia, between 11 and 16 June 2004 and the beamsize is ~ 36''. For each of the 15 sources only the central position was observed to obtain an overview of line strengths in order to optimize future detailed mapping observations. Most of the sources observed here have MSX associations (half of which are also candidates for UC HII regions), while only few are associated with IRAS sources and also with detected UC HII regions.

2. RESULTS

Figure 1 also shows sample spectra for two our sources MMS39 (a high mass star forming region) and MM54 (a pure millimeter source with no IRAS or MSX counterparts). As a first estimate we have assumed the physical conditions to be consistent with Local Thermodynamic Equilibrium and calculated the kinetic temperatures ($T_{kin}$) from the peak main beam temperatures of the optically thick CO line. The kinetic temperatures range between 15 to 20 K and have been used to calculate the hydrogen column density from the optically thin C^{18}O line intensities. The beam averaged hydrogen density is ~ 10^5 cm^{-3}. The line intensities of the optically thin tracers C^{34}S, H^{13}CO^+, N_2H^+ have been used to derive the abundances of these species (Table 1). The abundances relative to hydrogen range between 10^{-11} and 10^{-10}. This is consistent with the abundances of these species derived for massive star forming regions (Orion; Ungerechts et al. 1997; W3 IRS5 Helnich et al. 1997)

The 96 GHz methanol emission was analyzed using the rotation diagram method to determine the rotational temperatures ($T_{rot}$) and beam averaged column densities of methanol. The rotational temperatures so derived are far below the kinetic temperatures estimated from the CO intensities and lie between 5 and 10 K. Using the results of statistical equilibrium calculations for methanol at 25 K (Menten et al. 1988) the line ratio of the 2_1 -> 1_1E transition to the 2_{-1} -> 1_{-1}E for the different sources suggest local densities in excess of 5 10^5 cm^{-3}. In view of (i) the absence of higher excitation methanol observations and (ii) higher angular resolution spectroscopic data both $T_{rot}$ and column densities derived here are lower limits.

3. OUTLOOK

The analysis presented here is preliminary and will be refined using Large Velocity Gradient models and velocity components of individual spectra will be identified and analyzed separately. Detailed mapping observations of the individual sources are planned in the near future.

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Figure 1. 1.2 mm dust continuum map and sample spectra of MMS39 and MMS54. The y-axis are in $T_A$ scale.

Table 1. Properties of the 15 observed sources in RCW106 region derived assuming LTE

<table>
<thead>
<tr>
<th>Source</th>
<th>$\alpha$ (J2000)</th>
<th>$\delta$ (J2000)</th>
<th>$T_{\text{kin}}^a$ (K)</th>
<th>$N(\text{H}_2)^b$ ($10^{21}\text{cm}^{-2}$)</th>
<th>$n(\text{H}_2)^c$ ($10^3\text{cm}^{-3}$)</th>
<th>$[\text{C}^{18}\text{S}]^d$</th>
<th>$[\text{H}^{13}\text{CO}^+]^d$</th>
<th>$[\text{N}_2\text{H}^+]^d$</th>
</tr>
</thead>
<tbody>
<tr>
<td>MMS5</td>
<td>16:22:10.1</td>
<td>-50:06:06</td>
<td>48</td>
<td>4.90</td>
<td>2.7</td>
<td>3.4</td>
<td>0.8</td>
<td>0.6</td>
</tr>
<tr>
<td>MMS9</td>
<td>16:21:20.3</td>
<td>-50:09:45</td>
<td>14</td>
<td>1.67</td>
<td>0.9</td>
<td>2.1</td>
<td>0.4</td>
<td>2.4</td>
</tr>
<tr>
<td>MMS26</td>
<td>16:21:27.6</td>
<td>-50:24:56</td>
<td>52</td>
<td>5.58</td>
<td>3.0</td>
<td>1.2</td>
<td>1.0</td>
<td>1.5</td>
</tr>
<tr>
<td>MMS27</td>
<td>16:21:32.6</td>
<td>-50:25:20</td>
<td>71</td>
<td>7.46</td>
<td>4.1</td>
<td>0.9</td>
<td>0.1</td>
<td>1.0</td>
</tr>
<tr>
<td>MMS29</td>
<td>16:21:32.7</td>
<td>-50:27:12</td>
<td>43</td>
<td>4.99</td>
<td>2.7</td>
<td>2.1</td>
<td>0.3</td>
<td>1.5</td>
</tr>
<tr>
<td>MMS33</td>
<td>16:21:18.6</td>
<td>-50:30:25</td>
<td>43</td>
<td>2.51</td>
<td>1.4</td>
<td>1.4</td>
<td>0.3</td>
<td>2.6</td>
</tr>
<tr>
<td>MMS39</td>
<td>16:21:03.7</td>
<td>-50:35:23</td>
<td>48</td>
<td>9.65</td>
<td>5.3</td>
<td>4.0</td>
<td>0.5</td>
<td>2.1</td>
</tr>
<tr>
<td>MMS40</td>
<td>16:21:01.2</td>
<td>-50:35:54</td>
<td>71</td>
<td>9.28</td>
<td>5.1</td>
<td>3.0</td>
<td>0.4</td>
<td>2.4</td>
</tr>
<tr>
<td>MMS47</td>
<td>16:20:49.5</td>
<td>-50:38:43</td>
<td>45</td>
<td>6.50</td>
<td>3.6</td>
<td>1.6</td>
<td>0.3</td>
<td>2.5</td>
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<tr>
<td>MMS53</td>
<td>16:20:36.9</td>
<td>-50:41:00</td>
<td>48</td>
<td>2.96</td>
<td>1.6</td>
<td>1.2</td>
<td>0.3</td>
<td>1.4</td>
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<tr>
<td>MMS54</td>
<td>16:21:35.8</td>
<td>-50:41:11</td>
<td>33</td>
<td>2.34</td>
<td>1.3</td>
<td>1.5</td>
<td>0.2</td>
<td>3.3</td>
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<tr>
<td>MMS68</td>
<td>16:20:11.9</td>
<td>-50:53:17</td>
<td>36</td>
<td>6.48</td>
<td>3.5</td>
<td>3.2</td>
<td>0.5</td>
<td>1.4</td>
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<tr>
<td>MMS78</td>
<td>16:19:52.5</td>
<td>-51:01:35</td>
<td>36</td>
<td>3.19</td>
<td>1.7</td>
<td>3.6</td>
<td>0.3</td>
<td>2.3</td>
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<tr>
<td>MMS79</td>
<td>16:19:49.1</td>
<td>-51:02:24</td>
<td>24</td>
<td>1.86</td>
<td>1.0</td>
<td>0.7</td>
<td>0.3</td>
<td>2.2</td>
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<tr>
<td>MMS84</td>
<td>16:19:38.9</td>
<td>-51:03:28</td>
<td>50</td>
<td>4.09</td>
<td>2.2</td>
<td>2.3</td>
<td>0.3</td>
<td>1.7</td>
</tr>
</tbody>
</table>

$^a$ Estimated from CO(1-0) peak temperature assuming that the source fills the beam and the emission is optically thick
$^b$ Estimated from $T_{\text{kin}}$ and C$^{18}$O intensity assuming CO/C$^{18}$O = 500 and CO/H$_2$ = 8.5 x 10$^{-5}$
$^c$ Average density estimated from $N(\text{H}_2)$ assuming that the line of sight extent of the core is $D_{\text{cloud}} = 0.6$ pc (34$''$)
$^d$ Abundance relative to H$_2$ estimated using $T_{\text{kin}}$