ABSTRACT

This paper is a first contribution about the Mo Piu language and culture. This ethnic minority is settled in the mountains of the North Vietnam. This culture being not documented at all at the international level, its language is said ‘under-resourced’ in the point of view of the automatic processing.

After a cultural, social and economical presentation of this minority, the paper focusses on the results of the first field ground undertaken in June 2009, and especially on the data basis, and the first experiments on the Mo Piu speech (method and preliminary results). The study in progression is concerning the domain of human recognition of melodic segments in order to try to find out 1° if this language is tonal or not 2° and if so, what are the tonal units.

Index Terms— Mo Piu, ethnic groups, under-resourced language, endangered language, data basis, prosody, tonal units.

1. INTRODUCTION

Both in Vietnam and France, this project is based on the collaboration of linguists Vietnamese specialists of ethnic languages, French specialists of speech in the domains of phonetics, phonology, prosody, French and Vietnamese anthropologists, specialists of ethnic groups in Northern Vietnam, Province of Lao Cai, and computer scientists, working all together, which enhances knowledge, skillfulness, and outcomes quality.

Especially in conjunction with Christian Culas, we have laid in 2008 the foundation for a collaboration concerning an endangered ethnic group, the Mo Piu people in Vietnam, living in the mountains in the north, in an area protected from car passing and tourists. This ethnic group is of oral tradition only.

With this strong collaboration of researchers, the willingness of Vietnamese Government to develop the study of minorities languages, the ground of MICA technology in speech and pictures supplying a platform of computing tools and expertise, this project could be the first step to settle in Vietnam and South-Asia, a team (and at the same time a “base camp”) devoted to the study and preservation of endangered languages.

Apart from a humanitarian goal of making all documentation available to the ethnic minority, two other scientific objectives were defined. The first concerns a linguistic and ethno-linguistic study, conducted in conjunction between MICA, linguists specialists of asian languages both at the University of Social Sciences and Humanities, and at Université de Provence, France, and LACITO, the French anthropologists from IRASEC, and the Vietnamese ethnologists from the Department of Culture, Tourism and Sports of Lao Cai. The second objective matches the interests of MICA for the under-resourced languages. These last languages can benefit from the well-resourced languages of the computer resources and developments by the means of transfer and adaptation, particularly in the field of speech recognition and synthesis.

In this paper, we present the Au Co project focussed on the Mo Piu people, the method and the first experiments.

2. ABOUT THE MO PIU PEOPLE

2.1. General features

Though their exonym is Green Hmong, their endonym is Mo Piu (or Mo Brieu depending of graphy). Some of them told us that they can currently speak 7 or 8 languages and concerning the White Hmong they are speaking too, they
assert that there is absolutely no familiarity with that one; but because they are probably in instable position about their own identity, we must take this assertion with caution. So some questions have to be settled: for example is "Mo" just a transcription from their language for "Hmong" (which is Vietnamese)? Are they a part of Miao linguistic family – divided in China in Hmong, Hmu, Hmou and Xiong Miao subgroup – and according to Christian Culas hypothesis, a part of one specific group, the Hmou/Hmou or Hmou? [1][2][3][4]. All these questions need to be better investigated by linguistic and ethnographic inquiries.

Only investigations on phonetic, lexical syntactic, cultural and ethno-historical data could identify this ethnic group with more certainty. This population being not documented at all in the international bibliography about Vietnam, we hope nevertheless to find a link with some Chinese ethnic groups. So their origin is a problem due to a lack of knowledge. In fact, this small ethnic group is too small to be listed, and in these conditions either they are listed as Hmong, or they are beyond the census.

From 2003 Provincial Census, Mo Piu or “Green Hmong” in official designation, was 551 people; from June 2009 Census, there are 455 in 2 villages. By now children speak Mo Piu at 30-50%, and parents 70-80%. Parents are speaking Vietnamese to their children. A primary school works in the village where only the Vietnamese language is spoken and taught. 25% of people have been educated in the village school. No one has graduated college. Moreover nobody can write the Mo Piu language.

The names of the two Mo Piu villages are Nam Tu Thuong and Nam Tu Ha. "Nam" means "river" in Tay language (demographically, the Tay, linguistic family Tay-Kadai, are the most important ethnic group in the large area), "Tu" is the name of the «stream», and "Thuong" means "spring up". So when some families continued their migration lower towards Nam Xe, this new village was called "Ha" meaning "low". In Nam Tu Ha village, several ethnic groups are living together, and the language must certainly bear marks of all these cultures.

As Mo Piu is not documented at all, it is urgent to study several aspects: 1- phonetics and phonology, 2- lexicon, 3- morphosyntax, 4- prosody, tonologic and subjective expression (not only emotional), 5- ethno-history, 6- cultural specificities.

This is needed for compiling Mo Piu text books and dictionaries. This also contributes to popularizing knowledge on Mo Piu people.

2.2. Location
In the Nam Xe commune, 161 families are gathering 890 people, belonging to four ethnic groups Hmông (including White Hmong and Mo Piu or Green Hmong), Dao, Tay and Kinh. Mo Piu are 51% of the population of this commune, but the 2 villages are not in its centre.

The village of Nam Tu Thuong is situated in a sort of circus on the side of a hill, scattered on the left bank of the stream. All the houses are wooden, and without piles as the architectural model of Hmong and Dao. To get from one house to another one, there is no real path, people has to climb boulders left in their natural state, and finds their way sometimes through steep rocks. An organized communication way between the houses is exceptional, wandering most of the time across blocks of stone more or less big, circumventing or avoiding them, climbing up or down the slopes and steep paths. As electricity fails again to the village (but the poles were raised, which presages a next use), the evening traffic from one house to another is even more dangerous for the unfamiliar.

In fact the village of Nam Tu Thuong is divided into several sites: from an older village, Nam Can, located a few miles further up the mountain, went 7 families in 1963, who then have created the present village, now composed of 11 families and 227 persons. The oldest village comprises 12 families. It would also be interesting to investigate also there, if it still remains people.

2.3. Recent history
Formerly, the village of Nam Tu Thuong was that of Red Dao ethnic group (endonym "Ké Mien") who lived there long ago. Then, the Mo Piu arrived in the village of Dao, they used to live and clear the ground. In fact 5 families have left China about 350 years ago, to settle in an area more fertile.

The 5 families have crossed the river Nam Thi “Lang Si” and then the Red River to enter Vietnam at Y Ty (Bat Xat district). Sometimes later, the climate being too hard, people moved to "Mang Pang", now named Khau Bang (Mu Cang Chai District, Yen Bai province), around 50km from the current location. Though we didn’t know exactly why, they could not stay there long, so they left and came to the Nam Xe commune territory (Nam Tu Thuong village, Van Ban District), and there they settled.

2.4. About economy
The area of the village is about 17 hectares, plus 84 ha for agriculture, 13 ha of forest, 126 ha reserved for the annual crop, 8 ha of rice fields from the cooperative, 900 ha for growing in a long-term. The village of Nam Tu Thuong has 27 ha of rice fields farmed privately.

The economy has grown. In the village, each family has a forest where they grow wild cardamom (Elettaria cardamomum) under the shelter of a big tree. Some families have up to 0.5 ha. This mountain spice can provide important income for the local farmers; in 2000, dry cardamon was sold in the Sapa wholesale market, 160.000 Vnd/kg, about 10$US/kg. Unquestionably this is the most expensive local product after the end of opium production [5] [4]. Apart from this case, government
authorities help and encourage people to grow rice and maize, which thus supply a good productivity. The developing economy leads to increase the quality of life. Though the classification of “poor”, “very poor”, “medium poor” in Vietnam, especially in mountain ethnic area, is still the subject of many debates, according to the Mo Piu authorities, there are only 6 poor families or who do not eat their fill.

The Government invests to support Mo Piu ethnic groups, providing new roofs and water tanks for instance. In the village there are only 3 thatched houses. The machines shelling and husking paddy begin to appear.

3. DATA BASIS

On june 2009, we undertook a first field ground in the village. The team was composed of 2 Vietnamese ethnologists from the Departement of Culture, Tourism and Sport from Lao Cai, and two scientists from MICA, a linguist and an engineer specialist of audio/video recordings and computer processing. It was a great chance for the team to benefit from such a specialist because linguist and ethnologists could be better involved in their task with the speaker, and thus be better concerned with the scientific aspects and contents of the recordings, while they also benefit from a data basis well structured.

3.1. Method of recording

Before recordings, the linguist with the help of the speaker and of the team, filled up an inquiry form containing the most important information about this speaker. The audio and video recordings were made around a low table supporting the equipment and the microphones. To the linguist’s left side, stood a first ethnologist speaking English. Both were sharing the same microphone (track 1). Another ethnologist sat near her colleague. To the linguist right side, stood the Mo Piu speaker, then the translator who was translating oral question from the Vietnamese to Mo Piu language (then writing the responses Mo Piu / Vietnamese). The speaker and the translator both spoke in the same microphone (track 2). The engineer watching the monitoring settings was faced with all of us, with all the equipments, computers, camera, sound recorder. He was checking the good position of the microphones, of the camera vis-à-vis the faces, performing the zoom video, capturing recordings on the computer.

Each question (or songs, free speech) corresponds to one file. This facilitates the data distribution and also avoids losing too much time in case of wrong cancellation or system error. Furthermore it gives an instant overview of the richness of the topic.

At a signal from the engineer, in order to filling up the sound file header, the linguist gave the date, the speaker’s name, the theme addressed, the question number (track 1). The anthropologist immediately read the question translated in advance in Vietnamese (same track), which was immediately translated into Mo Piu (2nd track), and the speaker answered (same track). While the person was speaking, the translator wrote in Vietnamese what the person said. All the questions and answers translated into Vietnamese were grouped, then photocopied (later after our leaving, at our arrival in the nearest little town).

This whole methodology has been put in place quickly if not instantly. Once the explanation done on how we wanted to proceed, everyone has fully understood and fully played his/her role.

3.2. Data basis contents

We recorded on the whole 8 hours of films, gathering 1251 photos, 82 video-clips, 7 hours of speech, 1 hour of songs. In detail, the speech corpus length is 423 minutes, the songs or musical pieces, 59 minutes.

<table>
<thead>
<tr>
<th>Topics</th>
<th>Speakers Number</th>
<th>Recording number</th>
<th>Duration (mn)</th>
<th>TOTAL recordings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1- History</td>
<td>2</td>
<td>5</td>
<td>26</td>
<td></td>
</tr>
<tr>
<td>1- Tales</td>
<td>1</td>
<td>14</td>
<td>79</td>
<td></td>
</tr>
<tr>
<td>1- Folk songs</td>
<td>8</td>
<td>20</td>
<td>59</td>
<td></td>
</tr>
<tr>
<td>1- Music, instruments</td>
<td>2</td>
<td>20</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>1- Folklore</td>
<td>1</td>
<td>1</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>1- Past life</td>
<td>2</td>
<td>19</td>
<td>28</td>
<td>79</td>
</tr>
<tr>
<td>2- Birth</td>
<td>1</td>
<td>17</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>2- wedding</td>
<td>2</td>
<td>30</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>2- Funerals</td>
<td>1</td>
<td>4</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2- chamanism</td>
<td>1</td>
<td>28</td>
<td>29</td>
<td>79</td>
</tr>
<tr>
<td>3- Agriculture</td>
<td>1</td>
<td>8</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>3- Animals care</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>3- Hunting</td>
<td>1</td>
<td>10</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>3- Fishing</td>
<td>2</td>
<td>20</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>3- Tools</td>
<td>1</td>
<td>7</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>3- Costumes</td>
<td>2</td>
<td>25</td>
<td>31</td>
<td>64</td>
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<tr>
<td>4- Social overview</td>
<td>1</td>
<td>12</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>4- Village chief tasks</td>
<td>1</td>
<td>11</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>4- Village rules</td>
<td>1</td>
<td>5</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>4- Health problems</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>4- Agriculture problems</td>
<td>1</td>
<td>8</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>4- Language survival</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>42</td>
</tr>
<tr>
<td>5- Cooking</td>
<td>1</td>
<td>7</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>5- Children care</td>
<td>2</td>
<td>34</td>
<td>35</td>
<td>41</td>
</tr>
</tbody>
</table>

Table 1. Composition of the Data basis.

The data basis is classified per date / speakers / topics / questions (or songs, tales...), and finally we get 321 sound files and 321 video files. We recorded for speech 4 male and 3 female speakers. The male speakers are between 36 and 66 years, the female ones, between 37 and 72 years. Six are farmers, and among them, one is the village chief, another is working in the commune. The seventh is a chaman. The age range of the 9 singers (7 females, 2 males) spreads from 24 to 70 years. All are farmers.
The Table 1 above presents the topics addressed, the number of speakers per topic, the number of the items recorded (responses, free speech, songs, tales), the total per topic, and the duration in mn of each topic. Grounded on the duration, the most important topics for speech are: tales (79 mn), children care (35 mn), wedding (31 mn), costumes (31 mn), chamanism (29 mn), past life (28 mn), history (26 mn).

4. THE AIMS OF THIS STUDY

As this language is not repertoried at all, this exceptional situation allows to undertake innovative studies both in the domain of speech technologies, and in linguistics.

In this paper, we just want to put forward the linguistic study, its challenge, and the method used.

4.1. The goals of the first study
As we got no cues about the structure of this language, we don’t know whether it is tonal or not, and neither if the lexicon is mono- or plurisyllabic. In those conditions, we conduct a double study about tonality. Our goal is twofold:

1- to try to discover if the language is tonal or not,
2- if it is tonal, to try to identify the tonal units, and moreover to try to get rules to segment the language into lexical units.

In fact one more goal can be added to these ones: the need to build up a method and tools to find out the melodic units in the same time where we try to identify these units. No doubt that these goals are true challenges, but eventhough we fail in this tentative, we will get a deeper skill into the relation prosody / lexicon / syllable, that maybe we could not reach if we have been first studying the Mo Piu linguistic system.

In other terms, we are studying this language in the same conditions as computers may work, and thus, if this experience is successful, it could benefit for automatic processing in the domain of human language technologies. One of the applications concern the domain of the under-resourced languages called “PI languages” [6] in a multilingual processing approach aiming at rapidly developing spoken language technologies.

5. FIRST EXPERIMENTS

The acoustic data are analysed under specific speech software such as Praat [7] which is an international standard tool, in order to study formants and time events in the speech signal, MOMEL [8] which following the model of human perception, supplies a continuous intonation line even during the unvoiced speech events such as consonants, and finally an home tool MELISM [9] [10], specialized in the detailed analysis of prosody (F0, tones, duration) at the segmental level (word, syllable, tone, phonetic units), and which offers valuable complements to the previous ones for any kind of languages [11].

5.1. About the method used
As said before, our goal is to try to identify first the shapes of the melodic units (slopes direction, range...).This problem rests on the existence of the repetition of the melodic units invariants. Our experience of prosody and of tonal languages, make us expect the existence at the very least of:

1- kinds of shapes
   - plateaux: /P/
   - rising slopes: /M/
   - falling slopes: /D/

In our perspective, the plateau is considered as such when the rising or falling slope doesn’t exceed 25 Hz.

2- kinds of registers. 2 studies have been conducted, one exploring melody with 3 registers:
   - high: /h/,
   - middle: /m/,
   - low: /l/,

and the second one, with 4 levels:
   - acute: /a/
   - high: /h/
   - middle: /m/
   - grave: /g/.

In fact, we have to be aware of not confusing the phonologic level where probably only a part of these levels is significative with the phonetic one which describes the structure of the plateau or the slopes on several layers (see below paragraph 5.3.2.).

3- combinations of units (probably 2, please see details paragraphe 4.3.), at least
   - plateau + slope
   - slope + plateau

4- number of tones (if any): probably less than 10.

If this language is tonal, we could expect to detect some of these units presented above. The regularity of these tonal units, fixed in a few number of shapes, their F0 stability, could prevent us to confuse them with word melody segments which in a no tonal language are far more variable. In fact our task consists in sorting the units in 2 categories: the phonetical and phonologic segments. As this analysis is concerning tones, instead of phonetics we could use more appropriately the term of tonetics, in opposition with tonology.

If the melodic segments are corresponding to the tonologic units, the tonetical ones embrace not only their contextual or speaker variations, but also, if any, the tonetic space between 2 following tones. In fact due to the MOMEL script conception, as explained above, the intonation curve is continuous, even during the unvoiced
considered as the unit of reference. Since the
theory of Frame [12] giving a definition of the syllable at the
Another point about the method used concerns the syllable
decided not to compare our results before the end of our
Besides, in order not to influence the final results, we
will be made according to the musical mode.
In order to improve objectivity in the detection of the
5.2. The two experiments
In order to improve objectivity in the detection of the
tones (if any), we conduct the experiments in two different
ways. The first way is based on the tentative to recognise
these melodic segments only by the mean of the ear. This
task is undertaken by a linguist musician, and the notation
will be made according to the musical mode.

5.3. Illustration of the visual method (MOMEL-
MELISM under Praat)
5.3.1. Symbols and codings
The figure 1 above presents a speech extract from the Mo
Piu language (woman VTM, extract VTM02, spontaneous
speech), taken after the automatical segmentation and
labellisation under Praat / MOMEL / MELISM software¹.
3 windows are open simultaneously: from top to bottom,
the sound one with the speech signal and spectrum, then
just below, the manipulation one, providing the F0 curve
with on one hand the points corresponding to the
boundaries of units (candidates for tones and/or words)
and sub-units, all manually positionned, and finally the
MELISM window with several tiers: from bottom to top,
in the frame of the hypothesised syllables,
- the F0 values in Hertz,
- then above their conversion in semi-tones,
- then their alphabetic coding in 9 levels (g = grave,
  level 1 ; i = infra-grave, 2 ; b = bottom, 3 ; c = centred,
  4 ; m = middle, 5 ; e = elevated, 6 ; H = High, 7 ; S =
  Supra-high, 8 ; A = Acute, 9),
- then the F0 coding of the space between two
  boundaries (the so-called melodic syllables, for
  instance eH). In the frame of this present study, we
don’t use this level of melodic precision (neither the
coding in 9 levels nor melodic syllables).
- then the broad phonetic labellisation,
- and finally corresponding to the 2 last tiers, the
  tentative caracterisation of the supposed tones
  (everyone put manually) considering for the F0
description 3 or 4 registers (see below 5.3.2.).

In this last tiers, one can read the symbols corresponding
to the shapes of F0 segments we precised above (see §
5.1.), such as /P, D, M/ for respectively /plateau, falling
slope, and rising slope/, and just afterwards the F0 level
indicated in small letters: /b, m, h/ respectively for /low,
middle, high/ in the case of 3 registers for the F0 range,
and /a, m, g/ for /acute, high, middle, grave/ in the case
of 4 registers.
In order to simplify the reading and the analysis, all the
rising and falling slopes have been labelled with 3 cues:

1 The overlap of some F0 values, and the absence of some
codings in the tonal syllables (for instance H instead of Hm) are
caused by the size of the zoom.
after the indication if the slope is rising (M) or falling (D),
the second cue corresponds to the melodic level at the
beginning of the slope, and then the third cue, to the level
at the end of the slope. For example in the figure 1 above
/Dhm/ means that the falling slope begins at the high level
and reaches the middle one.
In the case of twofold codings, the sequence /Mmh-Ph/
means that the unit begins with a rising slope (M) in the
middle register (m) and reaches the high level (h), then
continues with a plateau (P) still in the high register (h).
Now /Ph-Dhb/ would mean that the sequence starts with a
plateau at the high level (Ph), followed by a falling slope
beginning in the high level (h), ending in the low one (b).

Last point to clear out: the brackets, for instance //Dmb/.
This notation corresponds in fact to our method of
segmentation based on the syllable and the privilege given
to the vowel nucleus. In the brackets, we put what we
supposed to correspond to tonetics and not to tonology,
such as F0 segments corresponding to consonants, not
only the unvoiced ones, but also the voiced ones as they
give some F0 modulations, and more generally F0
intervals between 2 melodic units.
The central part of the speech sample above on figure 1
(in blue or grey) is worth noticing, as the structure is
symmetric, arousing the question of a right segmentation:
for the syllable /dœj/ are they 2 tonologic items (/Mmh-
Ph/~/Ph/), or less (if /Ph/ corresponds in fact to the
phoneme /j/ and not to the coda of /œ/)?

5.3.2. F0 range: the number of registers in question
In the first phase of this work, we only used 3 registers of
the F0 range: /b, m, h/ for respectively /low, middle, high/,
wondering whether this partition of the F0 range could be
convenient. Examining the data, we saw a clear
disproportion of the number of plateaux: Pm (72 items),
Ph (30), and Pb (17). We thought then that a partition
between 4 registers (/g, m, h, a/ for /grave, middle, high
and acute/) could be thus more realistic. The new results
show that eventhough the distribution is better, the level
/m/ is still gathering the most numerous items: Pg (9), Pm
(50), Ph (39), Pa (21).
Anyway we have to remind that an adequate number for
the tonetic description is not necessary adequate for the
tonologic one, as the opposition of melodic height (same
form, different F0 levels) could only concern very few
tones, if they exist.
These 2 kinds of codings (3 and 4 registers) can be seen as
tiers in the figure 1 above, and as columns in the figures 2
and 3 below.

5.3.3. Data bank
When this phase of segmenting and labelling is over, the
MELISM procedure is automatically filling up a data bank
containing the list of all the items with their melodic
segments. This DB is a very performing tool, easily
enabling to compare all the melodic shapes, F0 indices
and duration, and then to observe at the best the repetition
of the F0 segments and units.
The file automatically filled up by the MELISM software
is divided in 3 parts. The first one contains the general F0
information about the sound file (F0 minimum, mean and
maximum). The second one gives an overview of the list
of the syllables (considered in this hypothesis as melodic
units), with the indication of their F0 structure such as
plateaux, rising and falling slopes (see above for more
details). The third one presents the detail of each melodic
segment composing the units. Then from each speaker’s
file of this kind, a big file is hand made gathering all the
data, and enabling to make statistic computations.
Thus the data are automatically sorted in 2 ways. The first
way sorts the syllables according to the vowel melodic
coding (Figure 2 below). So all the syllables supplying the
same melodic content are listed. For improving reading,
the same files under excell use the same colour. The
number of items supplies indeed relevant information
about either the validity of the tone as a melodic unit or as
a tonal one: the less numerous items, and the least
confidence about the phonologic status.
In the Figure 2, a suite of columns supplies successively
from the column 1, the number of the syllable in the list,
the name of the file, the phonetic coding (here the symbols
are not the IPA ones as these symbols are not known from
excell, but the source codings), the syllable duration in ms,
the coding of 1- the whole syllable including the
consonant and wovel (3 registers), 2- only the wovel (3
registers), 3- the whole syllable (4 registers), and 4- only
the wovel (4 registers).
This kind of data asks the question of the identification of
the melodic segment.

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file of this kind, a big file is hand made gathering all the
data, and enabling to make statistic computations.
Thus the data are automatically sorted in 2 ways. The first
way sorts the syllables according to the vowel melodic
coding (Figure 2 below). So all the syllables supplying the
same melodic content are listed. For improving reading,
the same files under excell use the same colour. The
number of items supplies indeed relevant information
about either the validity of the tone as a melodic unit or as
a tonal one: the less numerous items, and the least
confidence about the phonologic status.
In the Figure 2, a suite of columns supplies successively
from the column 1, the number of the syllable in the list,
the name of the file, the phonetic coding (here the symbols
are not the IPA ones as these symbols are not known from
excell, but the source codings), the syllable duration in ms,
the coding of 1- the whole syllable including the
consonant and wovel (3 registers), 2- only the wovel (3
registers), 3- the whole syllable (4 registers), and 4- only
the wovel (4 registers).
This kind of data asks the question of the identification of
the melodic segment.
For instance Figure 2 above, the twofold segment /Dhb-Pb/ (line 20, item n° 179) and /Dhm-Pm/ (line 8, item n° 3) are they the same one, one of them being a phonetic variation of the other one? If not, 3 registers zones are they enough? This problem can be easily solved by considering the 4 registers labelling. This one actually makes a clear opposition of the melodic levels /Dhg-Pg/ and /Dah-Ph/, which plaides definitively for 2 distintic melodic forms.

5.4. First results
In the overall, the Mo Piu intonation is a very melodic one, and often we wonders whether the person is speaking or singing. In our experience, it is the first language even heard of that kind. This impression comes from the presence of some special indices such as the use of big and rapid contrasts both at the pitch level and at the duration one, even if they don’t occur necessary at the same time, and moreover the existence of sorts of motives or ritorrelos based on symmetric notes.

In other respects, the samples analysed show the regular use of a lengthening before a pause, which may be a very long one. As the limits of the syllable are right now under discussion, in order to supply quantification in ms, we only chose in each case the duration of the lengthened vowel before a pause. For the 24 samples observed, this vowel lengthening spreads from 110 ms to 1000 ms, mean, 591 ms which is very long. Depending on a few examples, this result however is just of course a preliminary one.

The second point concerns the question whether the Mo Piu language is mono- or plurisyllabic. An argument in favour of this thesis stems on the length of the mean duration of the syllables: 378 ms. This duration is a long one, corresponding in fact to the length of plurisyllables in other languages. Moreover this mean duration encompasses great variations (from 40 ms to 1380 ms) in the same way as the mean duration of the vowels lengthening before pauses. Another argument is also the abundance of plateaux, as it is difficult to imagine a lot of plurisyllabic words made of successive and long plateaux. Grounded on these findings, the hypothesis of a monosyllabic language, seems the most reliable. This issue joins the following point.

The third point is now concerning the melodic segments and their components. As said before, the first evidence is the great use of plateaux. Over the 173 syllables, 68% are corresponding to plateaux, and among them, 42% of the 173 syllables are middle plateaux /Pm/. Based on this regularity, and the great amount of plateaux at different levels, we finally incline to thinking that the Mo Piu language is tonal.

In fact, we find (see Figure 4 below) either different syllables corresponding to the same tone (Figure 4, see circles Table above) or different tones for the same syllable (Figure 4, see circles Table below), which greatly confirms that Mo Piu is a tonal language. Moreover the great variation in duration suggests that this parameter plays a significative role at the lexical meaning. Besides 80% of the labelled vowels have a simple form. The fact that the complex forms are rare (20%) argues also for the role of duration (short ~ long) as a relevant parameter for meaning.

We are now considering the tonal content of the melodic forms (Table 2 below). In the Table 2 below, the tonal
codings concerning the 173 vowels (syllable nucleus) have been reported, with put side by side, in the left columns, the codings corresponding to the 3 registers, and in the right columns, the 4 registers ones with the new distribution of the same data. In a grey shade, the items with very few occurrences being in fact the tonetic variations of the other ones, can be easily discarded. They are many.

Figure 4. Extract of the data bank showing that a same melodic segment may correspond to different syllables, and conversely.

The words being monosyllabic, we can now support the theory that the syllable segmentation corresponds in fact to the word segmentation (eventhough the precise limits are still under discussion). In this case, some word tones seem to be good candidates:
- simple forms
  - for the plateaux (P)
    - 3 registers: /Ph/, /Pm/, /Pb/, or in the 4 registers version: /Pa/, /Ph/, /Pm/, /Pg/, - for the falling tones (M)
    - /Dhm/ both for 3 and 4 registers. A question remaining to explore is for instance for the 3 registers, whether /Dhm/ could be resolved with /Dmm/.
- for the rising tones
  - /Mmh/ for 3 registers,
- complex forms
  - /Dhm-Pm/ for both for 3 and 4 registers, which lead to the conclusion that /Dhm-Pb/ could be a tonetic variation for /Dhm-Pm/ (3 registers) as /Dhm-Pm/ (4 registers) suggests it.

For the complex forms, we have also to explore whether this opposition of forms /Dhm-Pm/ ~ /Dhm/ could not be resolved as well by a simple opposition in duration (for instance /Dhm-Pm/ resulting in fact to /Dhm/ long tone as opposed to /Dhm/ short one).

<table>
<thead>
<tr>
<th>3 melodic registers</th>
<th>4 melodic registers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melodic segments</td>
<td>Population</td>
</tr>
<tr>
<td>Ph</td>
<td>30</td>
</tr>
<tr>
<td>Pm</td>
<td>72</td>
</tr>
<tr>
<td>Pb</td>
<td>17</td>
</tr>
<tr>
<td>Pe</td>
<td>9</td>
</tr>
</tbody>
</table>

| Dhh                 | 1                   | Daa                 | 1                   |
| Dhm                 | 5                   | Dah                 | 2                   |
| Dmm                 | 4                   | Dhm                 | 6                   |
| Mhh                 | 2                   | Maa                 | 1                   |
| Mmh                 | 1                   | Mhb                 | 4                   |
| Mb                 | 2                   | Mnh                 | 3                   |
| Ph-CV-Pm            | 1                   | Pa-Dag              | 1                   |
| Ph-Mmh              | 1                   | Ph-Maa              | 1                   |
| Ph-Dhb              | 1                   | Ph-Mmh              | 1                   |
| Ph-Mhh              | 1                   | Ph-CV-Pm            | 1                   |
| Ph-Dhm-Pm           | 2                   | Pa-Dam-Pm           | 1                   |
| Ph-Dhm-Pb           | 2                   | Ph-Dmm-Pe           | 1                   |
| Ph-Mbh-Pm           | 1                   | Ph-Dhz-Pg           | 1                   |
| Ph-Meh-Ph           | 1                   |                     |                     |
| Ph-Mbh-Dmb-Pmb-Dhb-Pm-Mnh-Dhm-Pm-Mmh-Pb                      |
| Ph-Mbh-Dmb-Pmb-Dhb-Pm-Mnh-Dhm-Pm-Mmh-Pb                      |
| Ph-Mbh-Dmb-Pmb-Dhb-Pm-Mnh-Dhm-Pm-Mmh-Pb                      |
| Ph-Mbh-Pmb-Dmb-Pmb-Dmb-Pmb-Dmb-Pb-Dmb-Pb                      |
| Ph-Mbh-Pmb-Dmb-Pmb-Dmb-Pmb-Dmb-Pb-Dmb-Pb                      |
| Dhh-Pb              | 7                   | Dah-Pb              | 1                   |
| Dhm-Pm              | 7                   | Dmg-Pg              | 2                   |
| Dmm-Pm              | 3                   | Dmm-Pm              | 1                   |
| Dmb-Pb              | 3                   | Dmb-Pb              | 1                   |
| Mnh-Pb              | 2                   | Mnh-Pb              | 1                   |
| Total               | 173                 | 173                 |                     |

Table 2. Population of the tonal segments according to the 3 (left columns) and 4 registers codings (right columns).

Grounded on the argument of the tonetic variations due to the melodic context or the speaker, a deeper analysis of the other melodic items with a smaller population has to be undertaken, in order to minimise the number of the different forms.

6. CONCLUSION

This paper focussed on a first presentation of a language and a culture which have never been studied before. This study is very attractive and tempting because we work under exceptional circonstances: we attempt to discover the intonational / tonal system of a language without having no prior knowledge of it. Our experience of the
prosody and melody of various languages is our unique tool and safeguard.

We undertook this study carefully, step after step. For more security we based our investigation on the syllable considered as a stable reference unit. If the Mo Piu language is plurisyllabic, the remaining task consists in joining the syllables as simple bricks of the word unit. But we don’t rely on this hypothesis because it is impossible that any language could supply successive words with several syllables, each of them being most of the time long duration plateaux. If conversely, this language is monosyllabic, as our arguments seem to prove it, the word segmentation is near to be effective (it just remains to clear out the right limits of the syllable).

Based on this first experiment, the analysis of the melodic segments inclines us to establish that the Mo Piu language is tonal and monosyllabic. Moreover the first results show also clearly the repetition of a few tonal candidates, corresponding to

- several levels of plateaux (low, middle and high, i.e. 3 registers: /Ph/, /Pm/, /Pb/, or in the 4 registers version, acute, high, middle and grave: /Pa/, /Ph/, /Pm/, /Pg/).
- a F0 falling slope simple (/Dhm/) or more complex in two parts (/Dh-Pb/) if this opposition doesn’t finally stem on a simple opposition of duration.
- and for the F0 rising slopes, the /Mmh/ one.

Concerning the other candidates, less numerous, we have to study either they are simply tonetic variations to the other ones, due to the phonetic and melodic context, or due to the speaker, or true tones but naturally with less occurrences in this language.

At this state of the study, it still remains to find out how many tonal oppositions are relevant for the Mo Piu tonologic system, and what are their definitive shapes. For the moment, it is important to pay attention to all the cues which can supply right information about human recognition, as it could provide interesting paths and unexpected milestones for the needs of the automatic processings.

7. REFERENCES