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ANALYSING DRONE POLYPHONY

Research in multipart music is lacking any standardised terminology, which makes discussion difficult and hampers summarizing the many results of scientific research. Specifying culturally unconditioned basic components of the creation of multipart music, and seeing how they are shaped in a specific way according to the concepts of a particular culture are prerequisites for a standardized terminology.

First of all the phenomenological description has to be improved by taking psychoacoustic aspects into account, because psychoacoustics builds the bridge between the physical substratum of music and its perception, and psychoacoustic aspects are introduced into the creation of music via the musical experience of composers as well as by musicians. Phenomena such as auditory streaming, simultaneous masking, timbre effects and their mutual dependence have to be considered. This approach is illustrated by analyzing two examples of drone polyphony; the first one is an example from Georgia played by three *duduki.*

I

A duduki (v. At'ayan, 1984:615) is a cylindrical wooden oboe with a double reed that is very large in comparison to the body of the instrument and has eight finger-holes and one thumb-hole. Usually it is played with circular breathing. In Georgia it is not an instrument of folk music (Shilakadze, 1970) but "is held in store by the urban music in which Oriental and Western influences have merged with the indigenous tradition" (Ziegler, 1991; Manana Shilakadze, personal communication, 27. Sept. 2004). The example we have selected for analysis is played by the Duduki Trio and was published by the German label World Network in 1991 under the title "Collection of Ancient Georgian Urban Songs" (World Network LC 6759, track 24).

In reference to the musical texture the composition is divided into 4 sections (fig. 1): a melismatic melody accompanied by a drone (sections A and C), and two three-part melodies in a harmonic texture (sections Â and D). Since the subject of our paper is drone polyphony, the analysis is focused on section A and section C. As one can hear, the drone does not appear as a steady state sustained tone, but its loudness fluctuates more or less regularly. A spectrogram (fig. 2) shows clearly what happens. The upper part of the figure shows the spectrogram of the beginning of section A from zero to 1.500 Hz. The lower graph shows the RMS amplitude of the frequency band where the fundamental of the drone spectrum is located. We can see distinct beats, both in the spectrogram and in the RMS plot, and these beats are plainly audible.

Beats occur when two sound waves of slightly different frequencies are superimposed. The resultant sound wave then shows periodic variations of the amplitude of the beat frequency f_2 minus f_1 and we hear a single beating tone. We assume that in our example two instruments of the trio play the drone simultaneously, but unison is, intentionally we assume, not perfect, so that beats occur. This assumption is based on the observation of relatively fast amplitude modulations up to seven per second to the extent of more than 15 dB, and these amplitude variations let us assume that the modulations described can not be produced on one instrument only. Our assumption is further supported by the discovery of a certain pattern of the beating drone, which is repeated several times in the course of section A of the recording and also exists in section C. Let us start our analysis with section A.

The drone pattern is clearly found at the end of section A (fig. 9). The upper graph again shows the spectrogram of the melody together with the drone. In the lower trace, the RMS amplitude values of the frequency band from 235 to 245 Hz are displayed, containing the fundamental frequency of the drone spectrum only. We can observe a sequence of 26 beats grouped roughly by two classes of different beat rates. Type S (slow) shows a beat rate between 1.9 to 3.1 Hz, the beat rate of type F (fast) is significantly higher, at 3.4 to 4 Hz. The pattern ends with three sustained tones without audible beats. If there are any, they are masked by the melody.

This pattern found at the end of section A has been taken as a model for further analysis of the whole of section A., and it has been proven that this section consists of a continuous sequence of eight patterns comparable to the model with slight variations: The model fits to pattern #2, 3, 4, 7, and 8 closely (fig. 3, 4, 5, 8, 9) whereas patterns #1, 5, and 6 (fig. 2, 6, 7) are extended.

Summarizing the analysis so far, it can be stated that the structure of section A of the sound example is given by an eightfold sequence of a specific drone pattern. This proves the assumption that the production of the drone formed by beats is not accidental, but apparently follows a certain musical concept. A further proof of the existence of a musical concept would be if a coincidence of the drone pattern with the melody could be found. Indeed there is a certain correspondence, even though it is a weak one: The melodic part of section A consists of 9 phrases (fig. 10f.). Phrase #1 begins with a delay, and its end coincides with the end of drone pattern #1. Phrase # 2 begins overlapping with drone pattern #1 and ends with drone pattern #2. Phrase # 3 begins again overlapping and ends with drone pattern #3. The sustained tones at the end of drone pattern #1, 2, and 3 take up the rests between phrases #1 to 4. Phrases #4 and 5, separated by a short rest, builds a block which finds its end in coincidence with drone pattern #5; analogous to phrase #1, the entry of phrase #4 is delayed. The phrases #6 to 9, again separated by short rests, form a longer block which does not end until in coincidence with drone pattern #8, where section D starts.

The drone pattern as identified in section A proves also to be determining section C. As an example, see fig. 12. Here again we have to ask: “Is there a certain relationship or correspondence of the drone patterns with the melodic phrases?”. As in section A there *is* one, but the correspondence is rather loose. Section C (fig. 13) starts with a very abridged version of the drone pattern, namely only with its cadence built by the long sustained tone introduced by one fast beat and repeated twice or three times. In comparison with the patterns of section A, these sustained tones in section C are definitely longer in most cases. Drone patterns #1, 2 and 3 (fig. 14) are connected in a continuous sequence which ends in coincidence with phrase #6. We can see that the entry of the short phrase #1 is delayed. Phrases #2 and 3 begin and end within drone pattern #1. Phrase #4 begins overlapping with the final sustained tone of drone pattern #1 and covers drone pattern #2 and the first part of drone pattern #3. Phrases #5 and 6 follow and find their end together with the end of drone pattern #3. Drone patterns #4 to 9 (fig. 15) finally form a second continuous sequence which find its end with phrase #15.

Summarizing the relationships within this second sequence of patterns, one can say: (1) The last two drone patterns and phrases before the short section without drone starts coincide perfectly, and (2) After this droneless section there are good correspondences between drone patterns and melodic phrases (fig. 16). Thus we can say that both in section A and in section C there is a certain correspondence between the drone patterns and the melodic phrases, and that the structuring of the drone part by beat sequences is obviously done intentionally.

Summarizing the results of the analysis of the first example of drone polyphony: our analytical approach revealed a *rhythmic drone* (rhythmisch gegliederten Bordun) as defined for example by Rudolf Brandl in his comprehensive article in *Musik in Geschichte und Gegenwart* (Brandl, 1995:72). But the drone in our example played by the Duduki Trio is not structured by accents, rests or repeated attacks as Brandl states; rather, it is structured by means of beats. Thus we would like to introduce the term *drone by beats* or another equivalent to the German word *Schwebungsbordun* into drone terminology and pose it for discussion. With reference to its tonal function (Brandl, 1995:74) it is a *key note drone (Grundton-Bordun).*

The results of our analysis support the assumption that fashioning the drone by beats has been done according to a certain musical concept. Unfortunately we currently have no information about such a concept. That is why we can only speculate. We have seen that the identified drone patterns are composed of two elements: beats and sustained tones. The beats occur in a fast and a slow variety. The question arises: Is there a fixed rule as to how these elements have to be combined? Is it a matter of improvisation? And what about the way of producing the beats: is it by embouchure effects or by subtleties in opening and closing the finger-holes? The answer has to be given by observations in fieldwork.

II

The second example of drone polyphony we have selected for analysis, is a *Bolgarski Rospev*, sung by the Yoan Kukuzel Angeloglassniyat Ensemble in 1987 in the Alexander Nevsky Memorial Church in Sofia and published by Balkanton (050012/1).

Drone as an element of Byzantine ritual liturgical singing is called *ison*. According to Elena Tončeva (1991:147), the earliest evidence for this practice in Bulgarian liturgical chant goes back to the 13th century, and according to Kenneth Levy (1980:561), this practice was well established in the mid-15th century. There are several types of *ison* in liturgical singing. Our example is characterized by a sustained complex tone based on d_2 as its fundamental and sung over a constant back vowel. Attempting to give an answer to the question "What are the psychoacoustic consequences of this kind of drone, and how are they used in musical composition" would require a comprehensive study including analysis and experiments. We can only give some hints by taking the first section of the song for a rudimentary analysis:

The spectrum of the drone is clearly displayed in the spectrogram (fig. 17) by straight horizontal lines, one on top of the other, up to about 1000 Hz. Partial #6 appears to be the strongest component of the spectrum, apparently as a consequence of the articulation of the back vowel. We can also see that the fundamental of the drone is physically very weak, but because of its nature as a so-called virtual pitch it is present throughout the whole segment. Thus the spectrum of the drone shows a certain profile featuring two important components: the fundamental tone of the melodic mode and the fifth some octaves higher. Figure 18 shows this fact more clearly: It shows the amplitude spectrum at a point about 4 seconds from the beginning of the song. The drone and g_3 of the melody are sounding together. The masking threshold shows that only those components are relevant for perception which have a peak in the curve. We see that partial #6 of the drone (B6) is almost as strong as the strongest partial of the tone of the melody (M3).

Partial #4 of the drone (B4) is masked, and the amplitude of the fundamental of the drone (Bl) is lower by 32 dB than partial #6 of the drone.

Now the melody is embedded into the frame set up by the spectrum of the drone, which has a very strong sixth partial and, perhaps as a consequence of the recording situation, a physically very weak fundamental, which is nevertheless existent as a virtual pitch. Depending on the course of the melody, first the tone d_2 is perceptually favoured, then a_3. Two figures will illustrate that. The first (fig. 19) is taken from a sound segment where the drone and *b/flat*$_3$ of the melody are sounding together. It shows the interference between partial #2 (M2) of the melody tone and partial #6 of the drone (B6). Something similar occurs one octave lower between partial #1 of the melody tone (Ml) and partial #3 (B3) of the drone. In this case partial #6 of the drone, the fifth, becomes inaudible as an isolated tone, and d_2, the pitch of the fundamental of the drone, is more prominent. In contrast, fusion occurs when partial #3 and 6 of the drone corresponds with a_3 of the melody (fig. 20).

With regard to the musical function of the drone in the Bulgarian example, we can say: (1) The *ison* clearly demonstrates the important role of the fundamental tone and the fifth above it in the specific musical mode; (2) the *ison* anchors the melody in musical space (a) by expanding downward the borderline set by the sounding area of the melody, and (b) by putting the melody into a reference grid. With regard to its temporal structure (Brandl, 1995:72), we have a *sustained drone*, and with regard to its cognitive function (ibid.:74), it is what is called in German a *Gerüstbordun*.

These were some illustrations of an analytical approach that we propose in order to improve the phenomenological description of music as a prerequisite for developing a terminology of multipart music.

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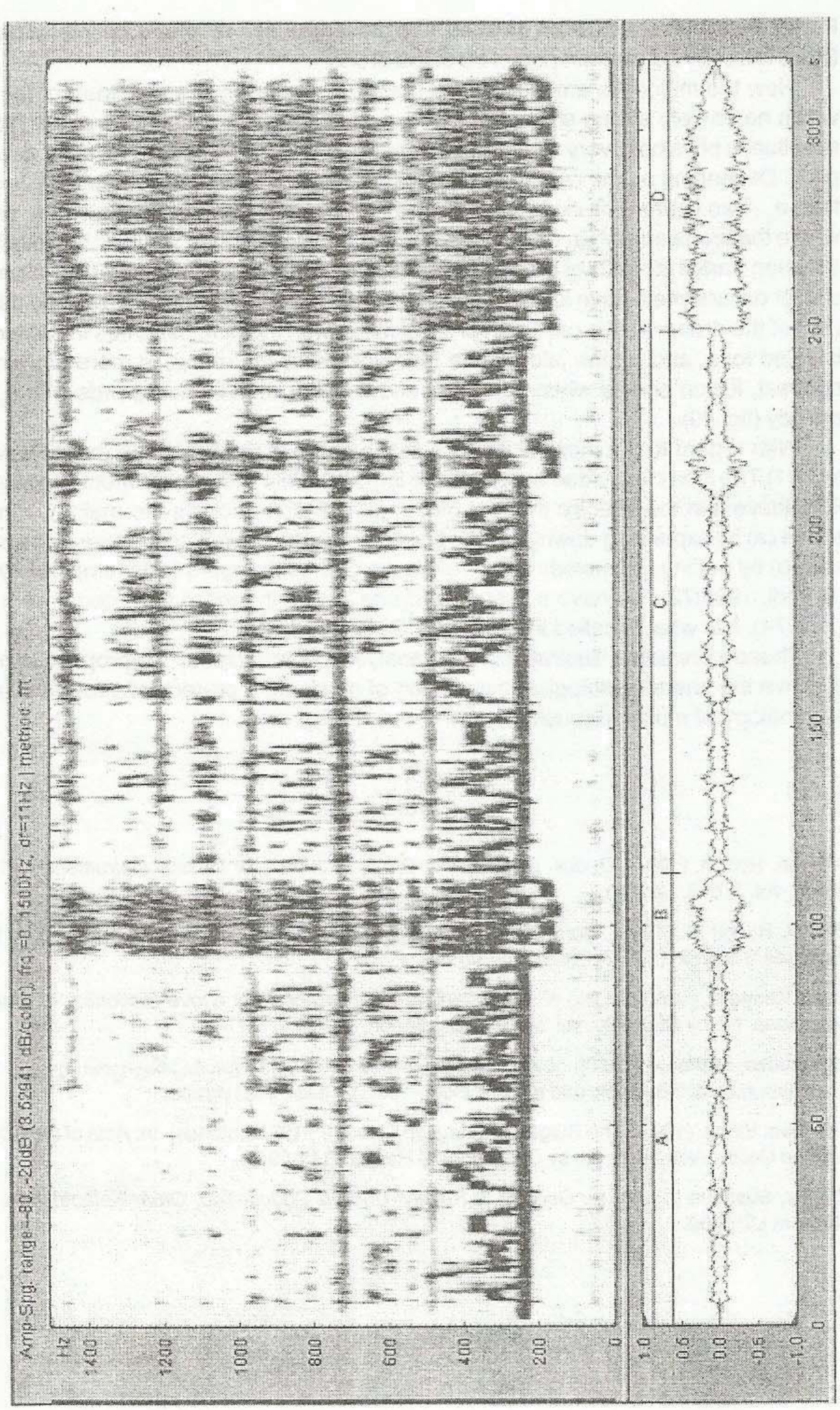

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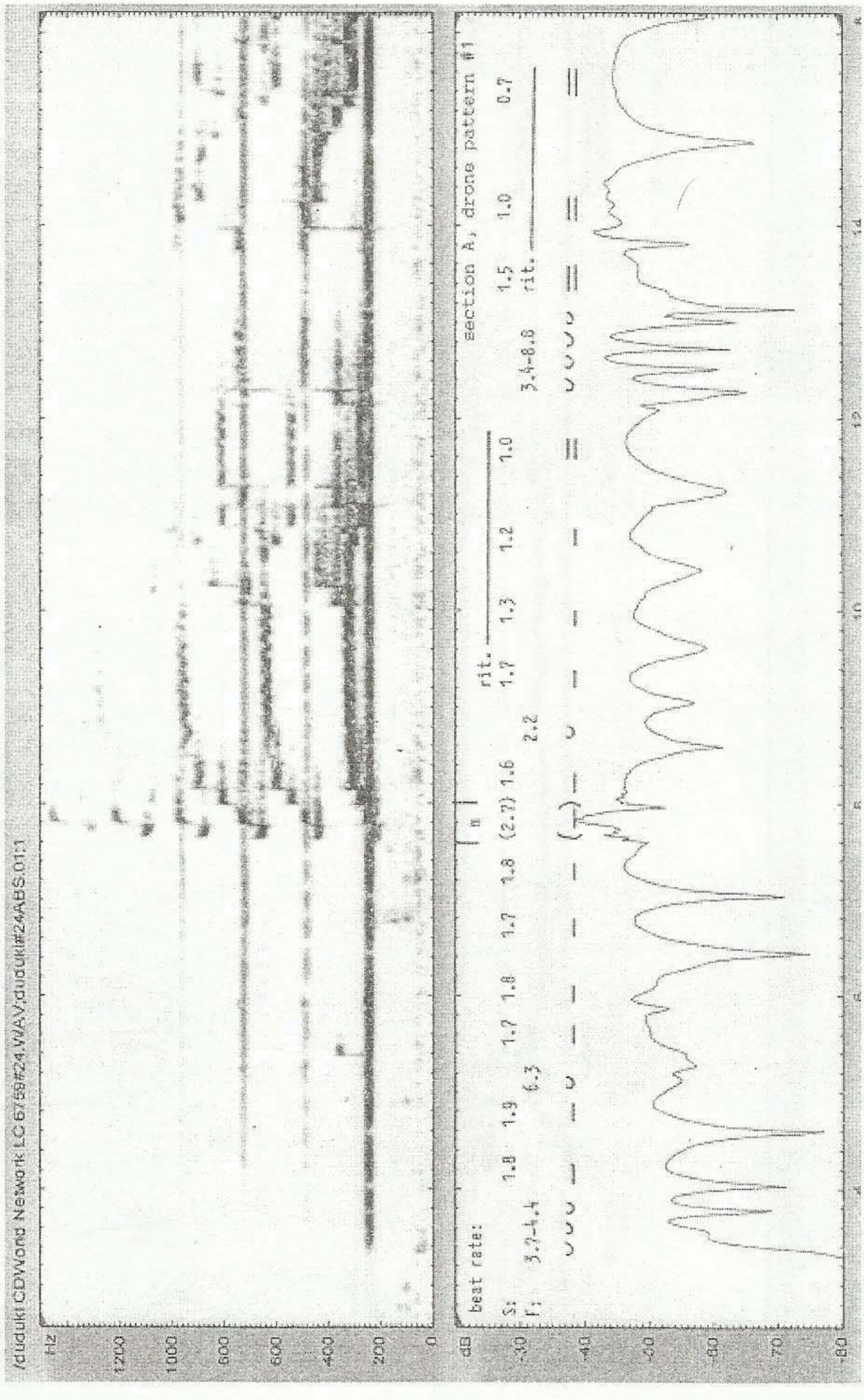
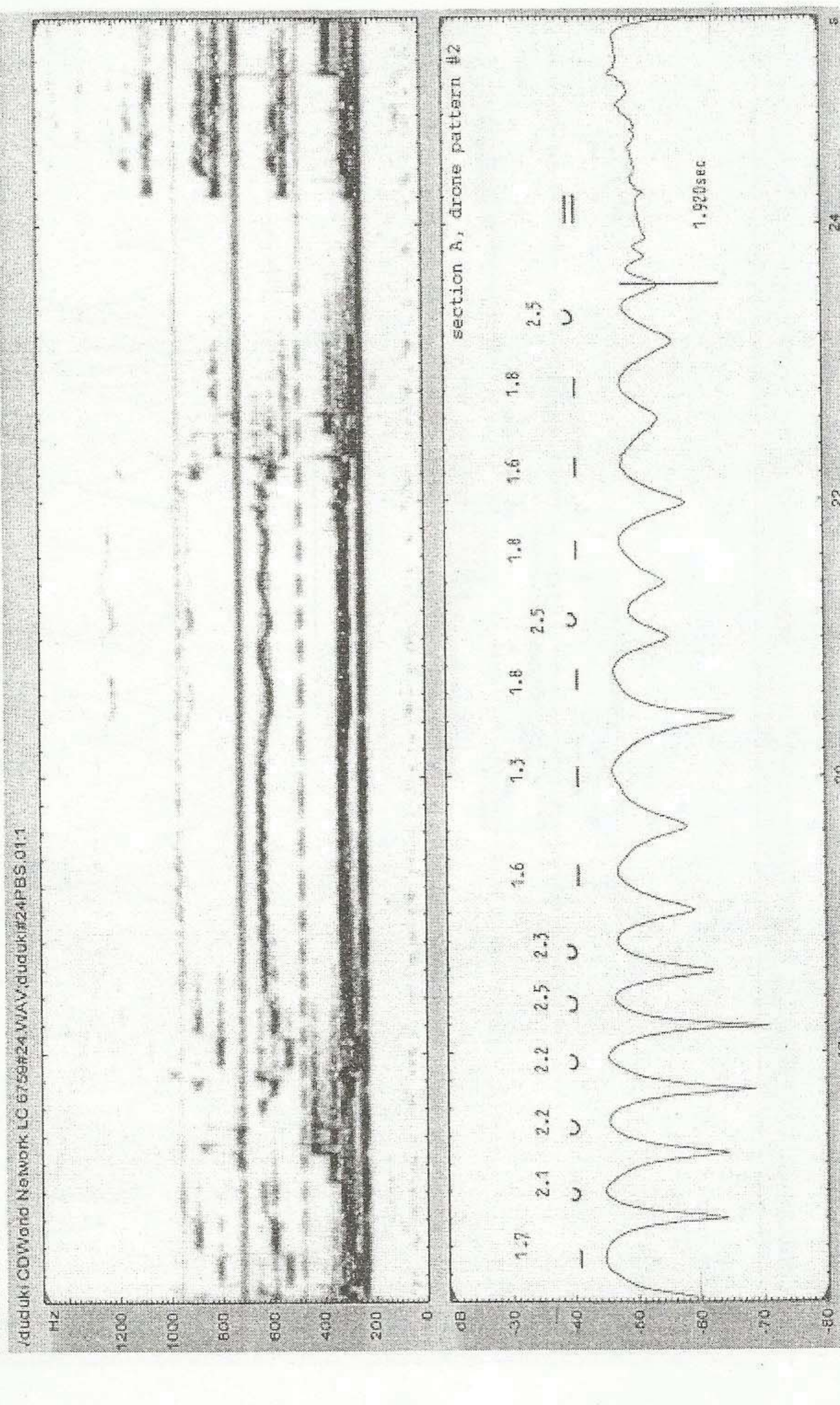
FIGURE 1.

სურათი 2.
FIGURE 2.



სურათი 3.
FIGURE 3.



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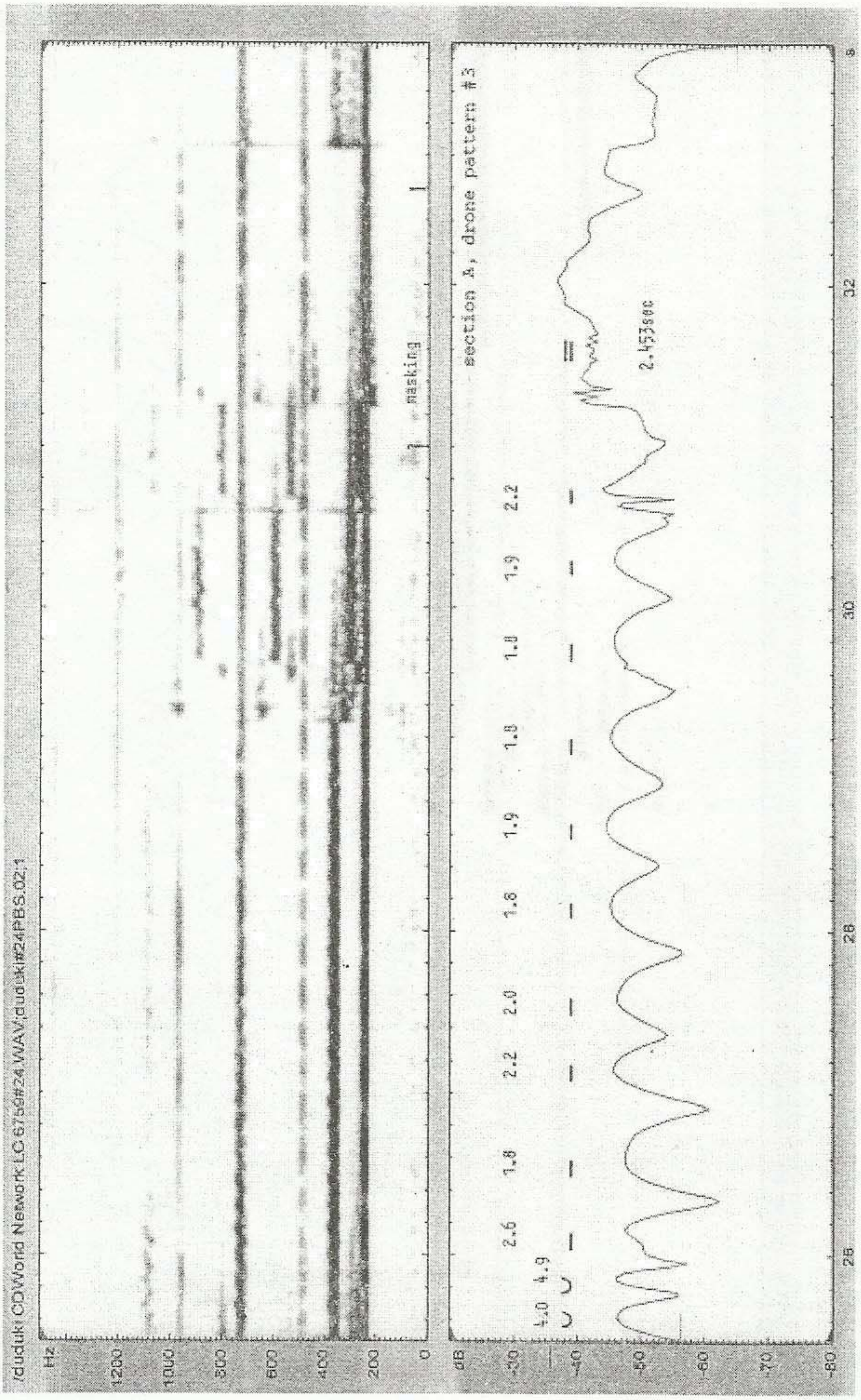

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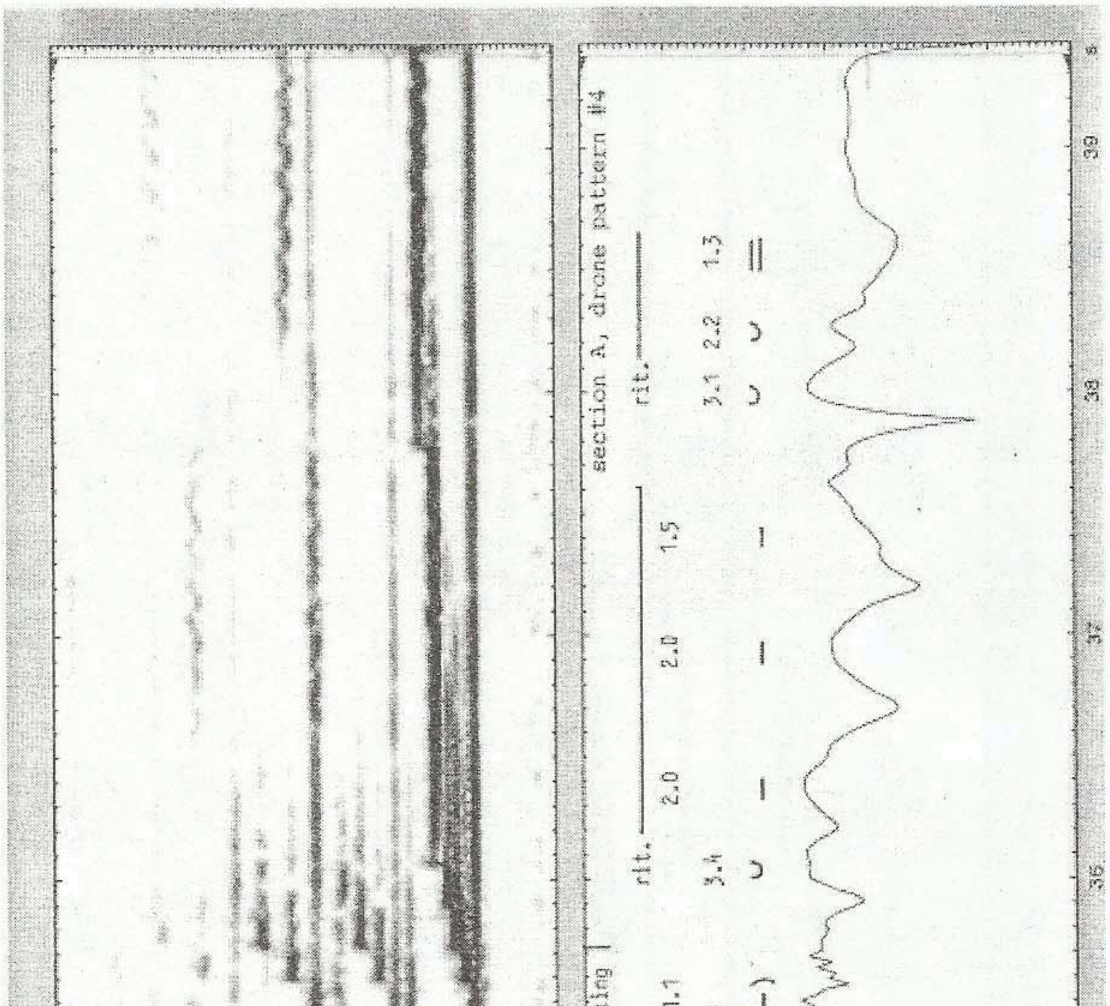

ნახაზი 6.
FIGURE 6.

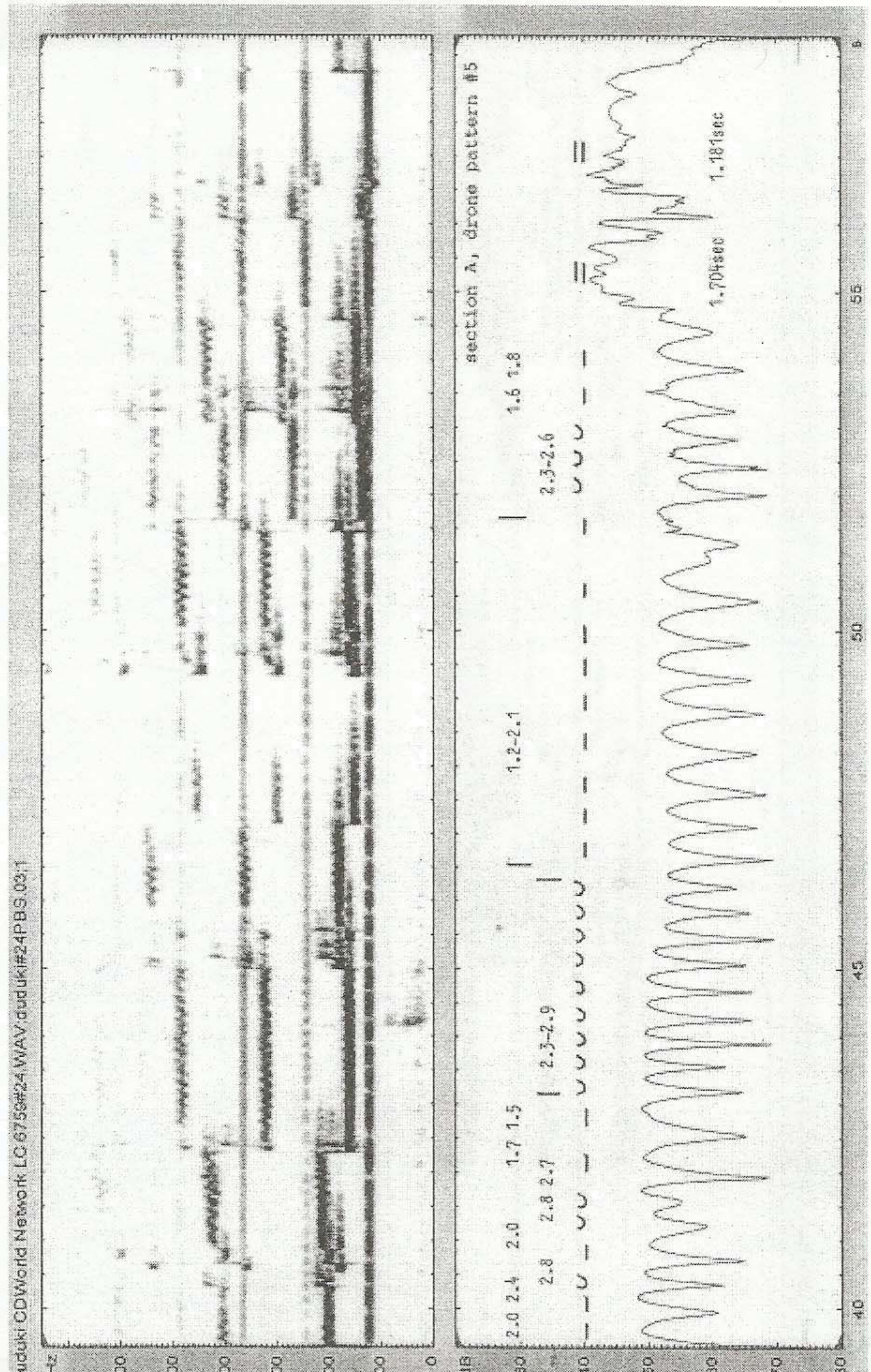

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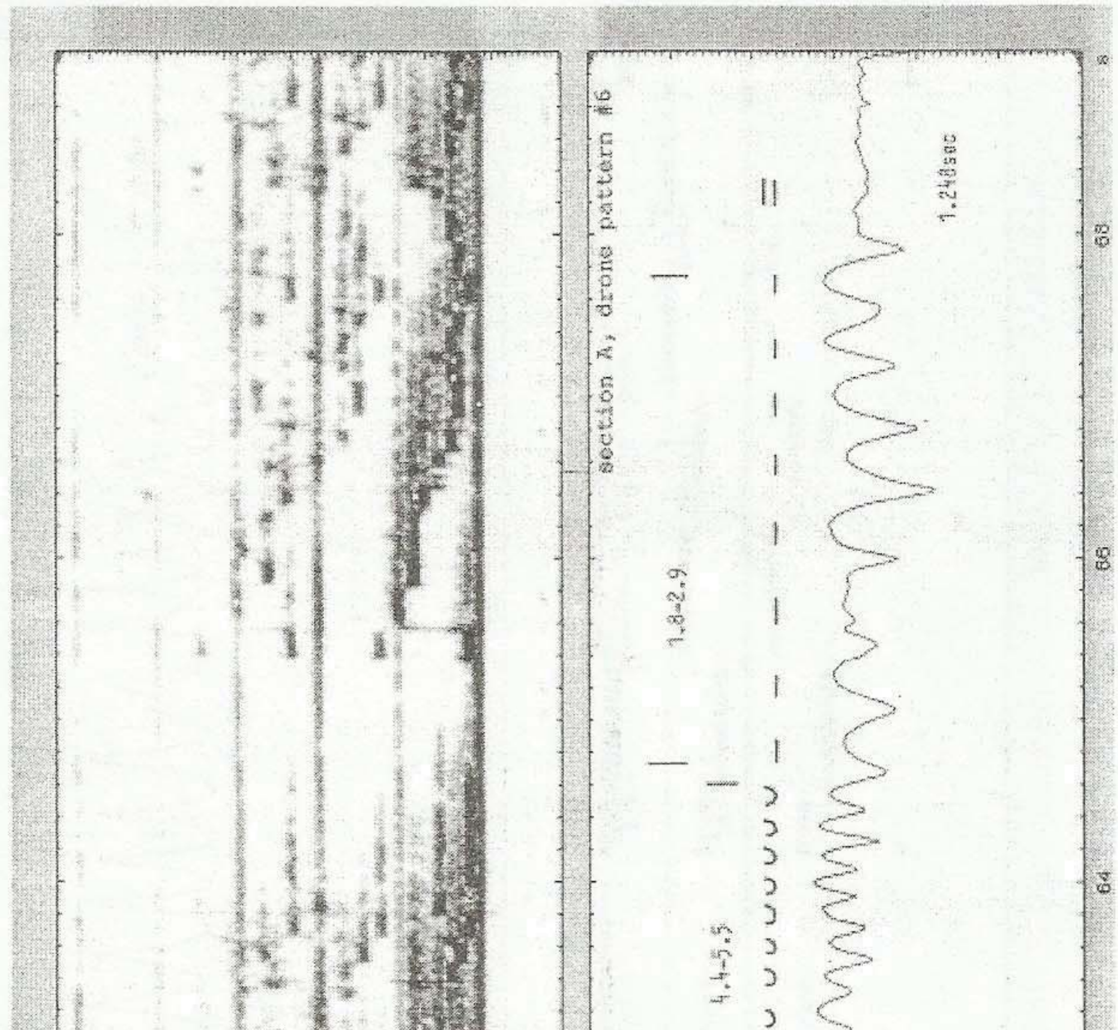
FIGURE 7.



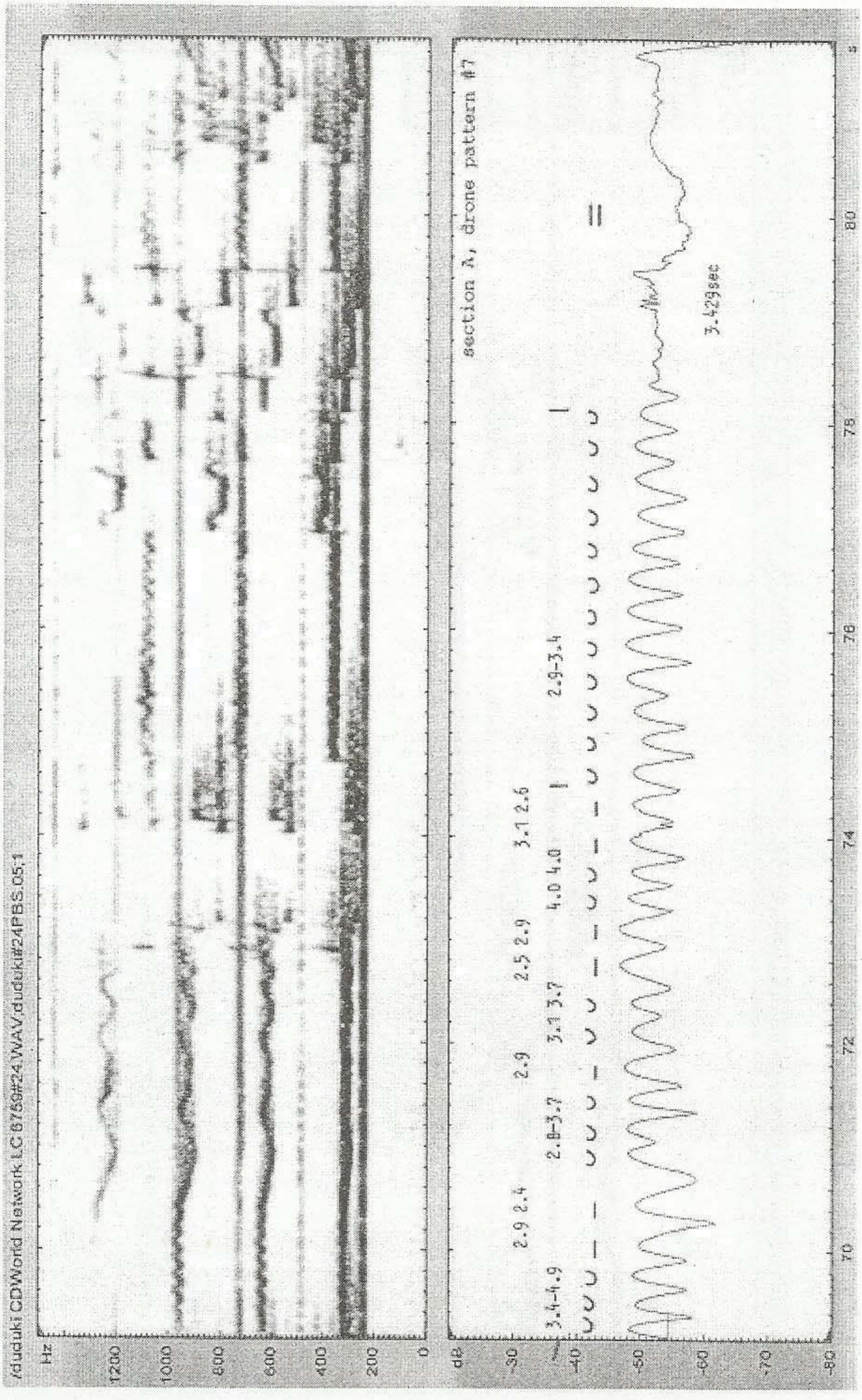


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FIGURE 8.

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FIGURE 9.

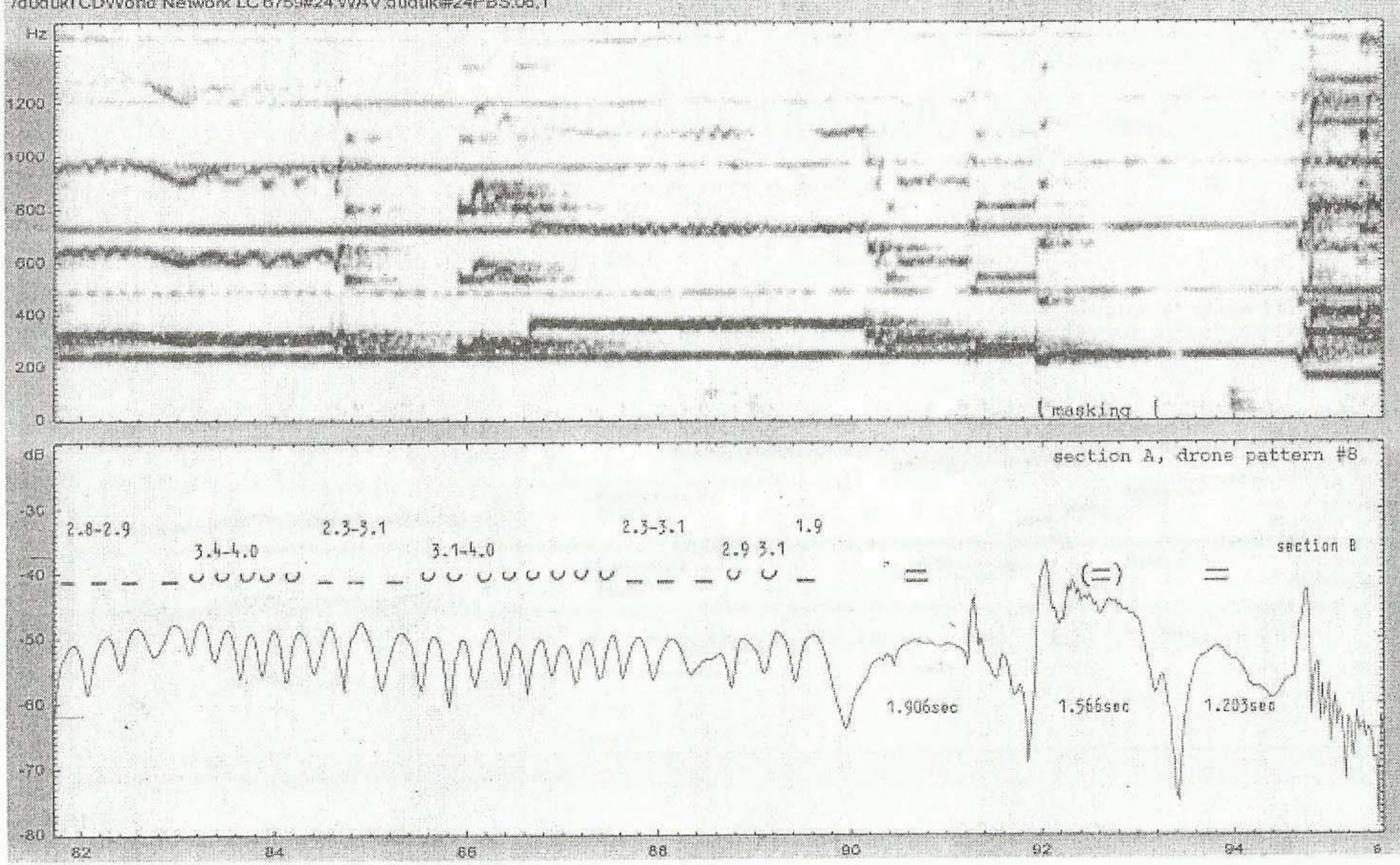

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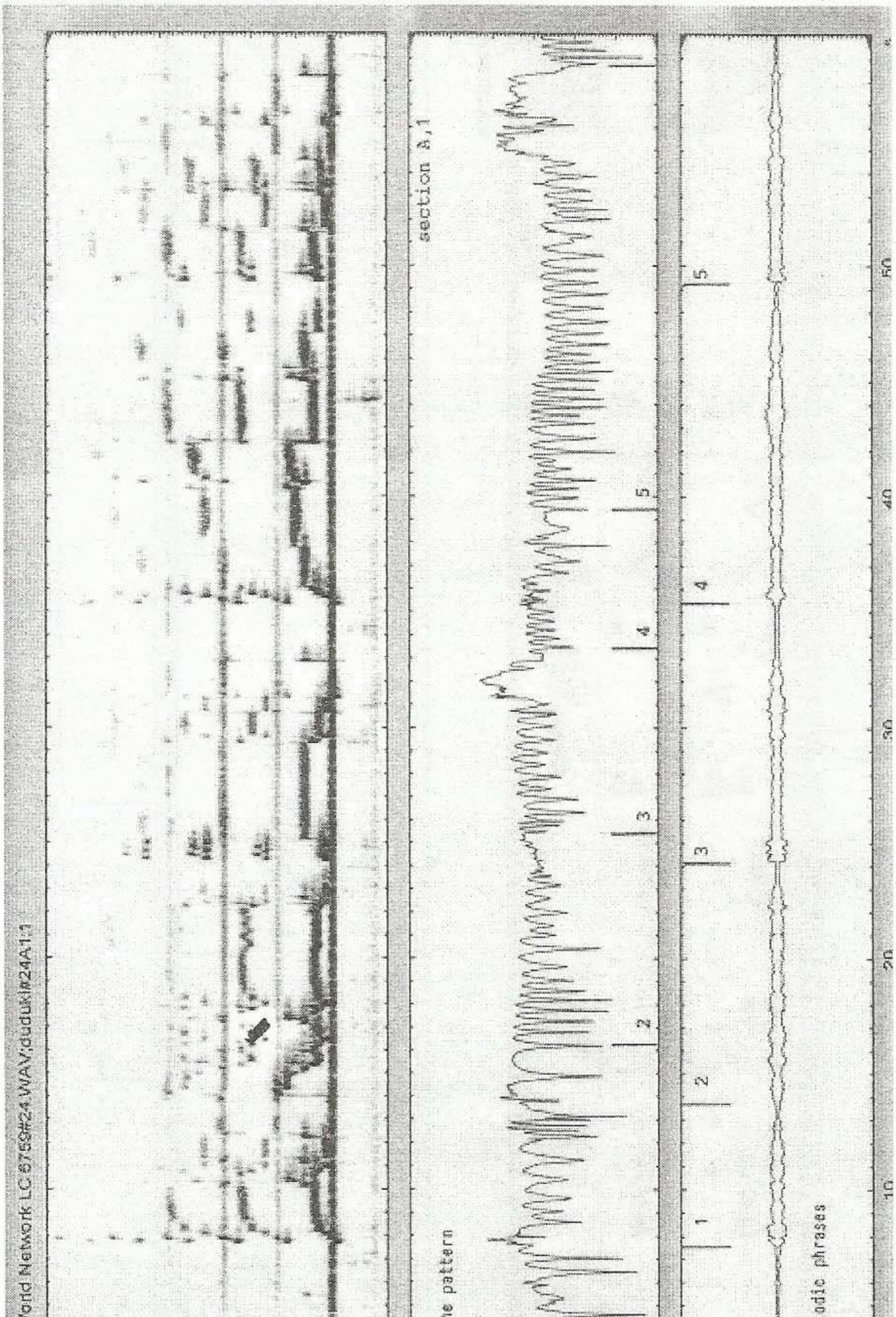
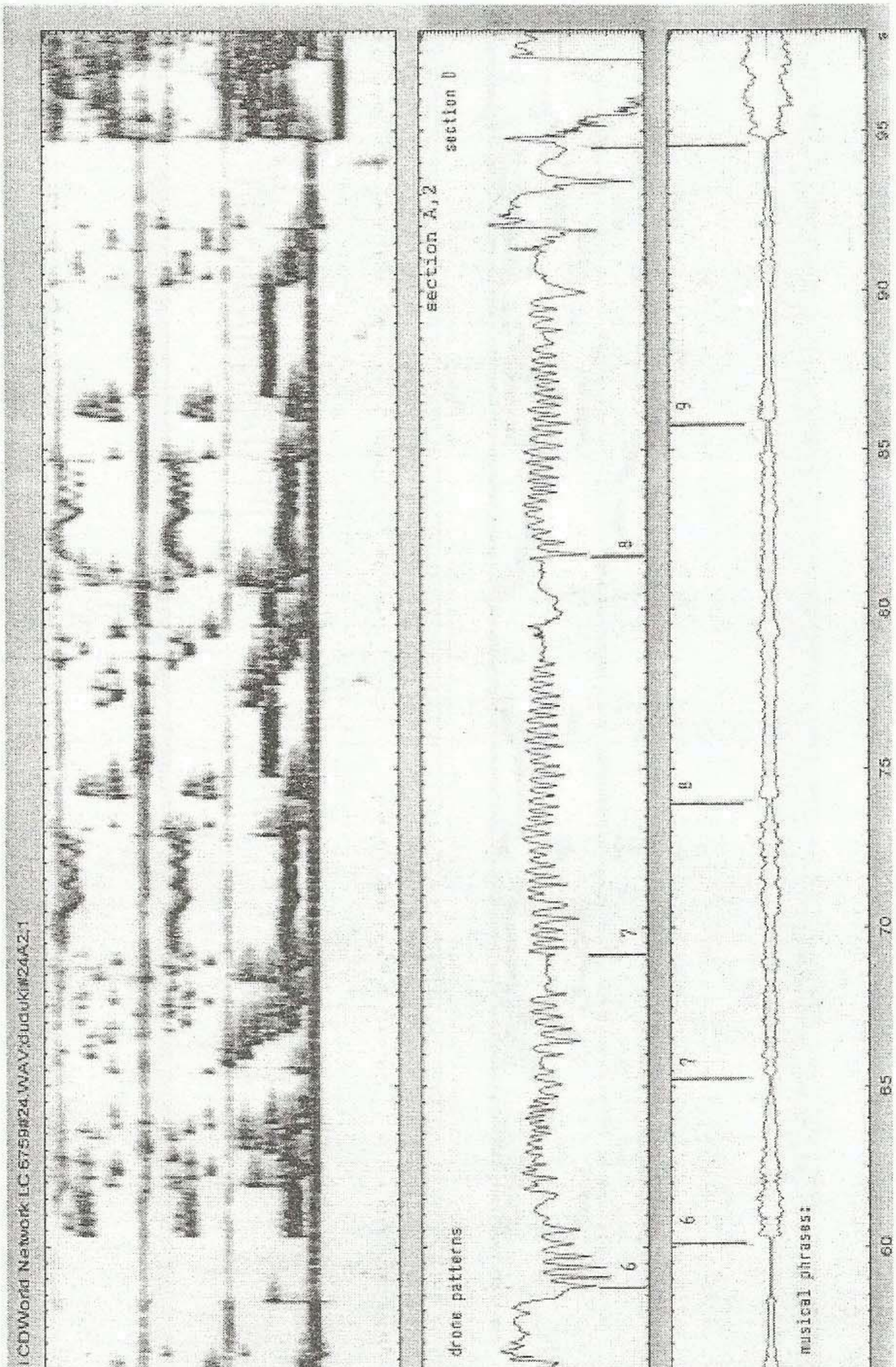
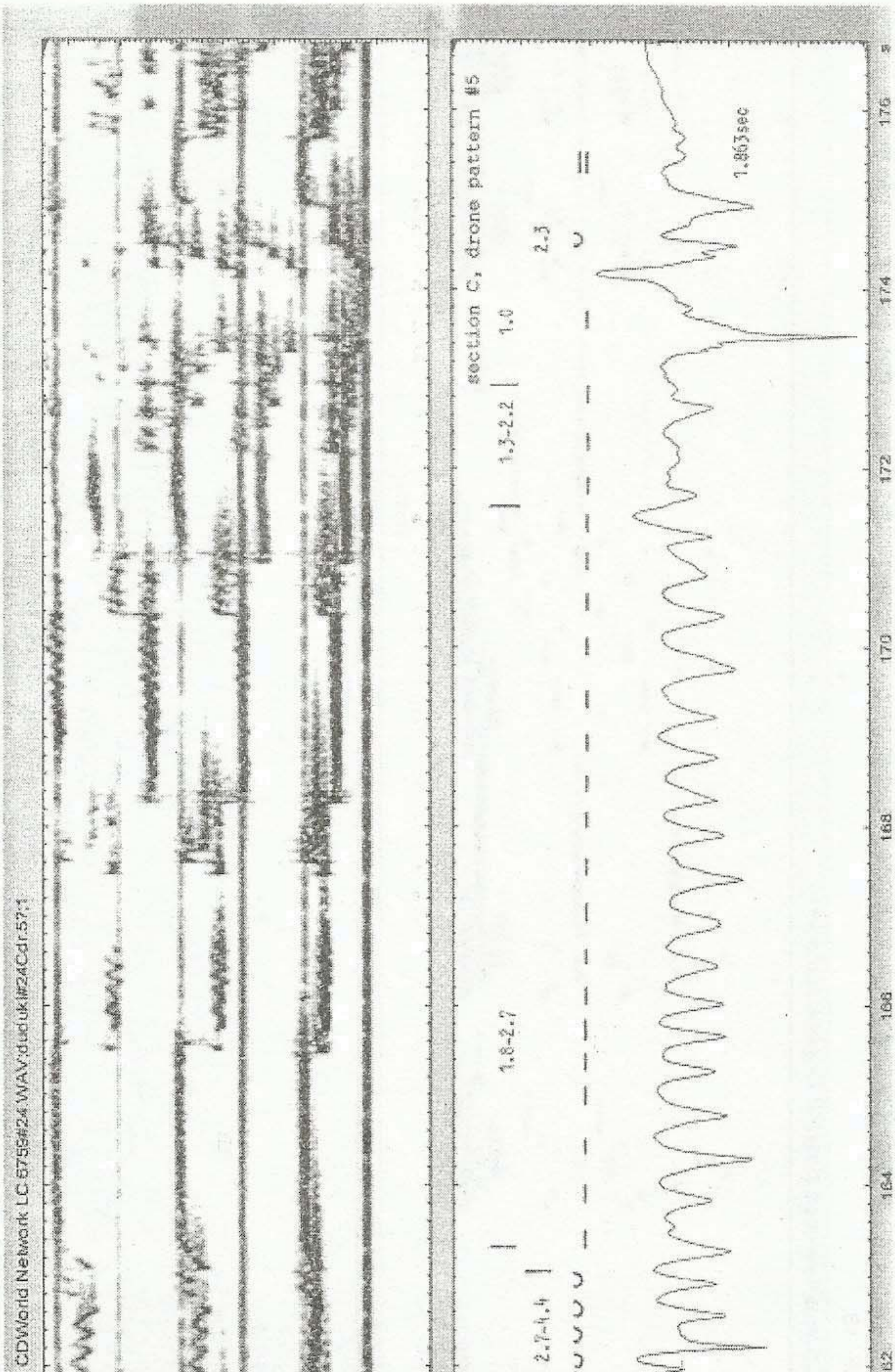
FIGURE 10.



სურათი 11.
FIGURE 11.



სურათი 12.
FIGURE 12.



ნახაზი 13.
FIGURE 13.

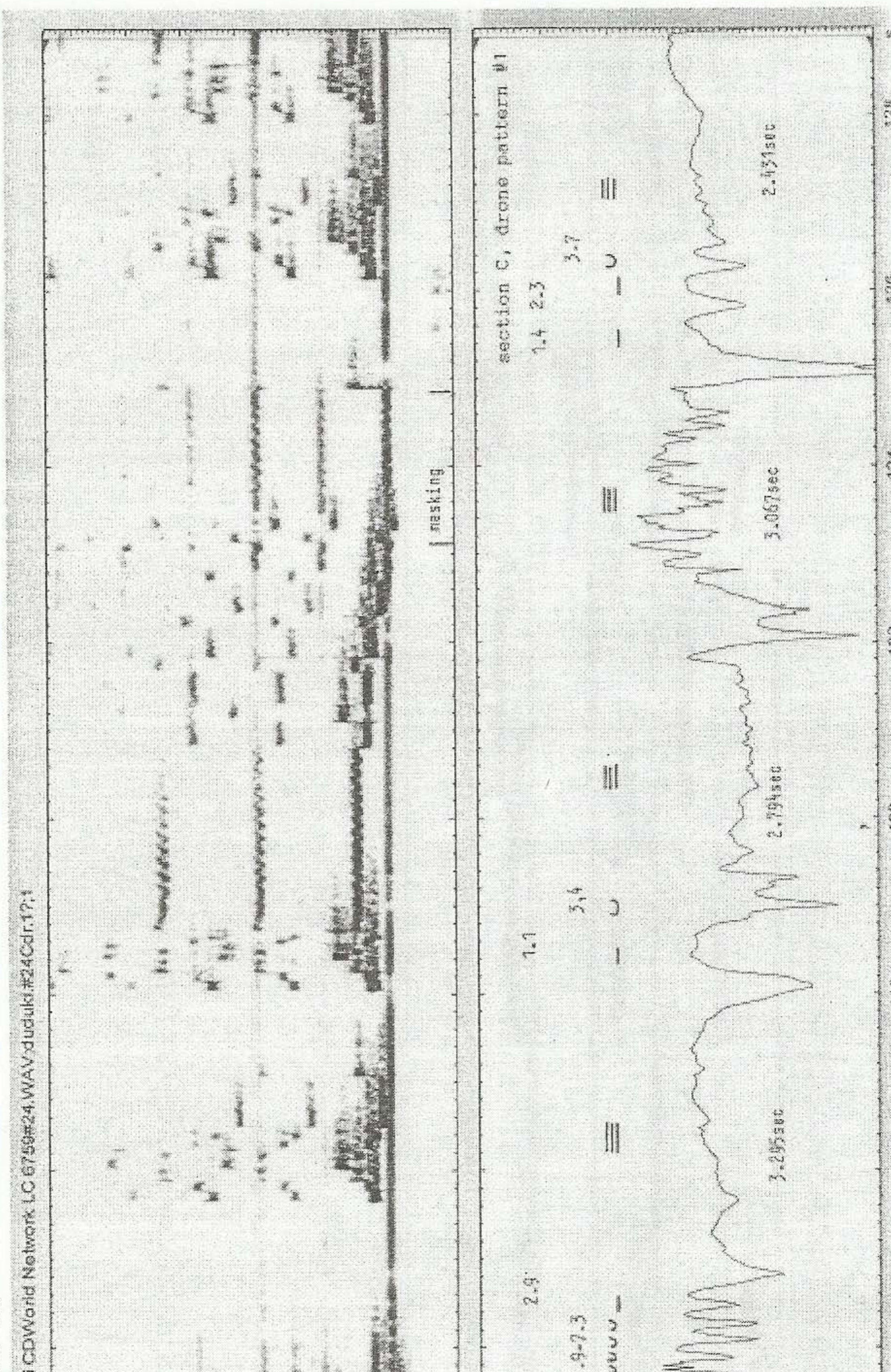


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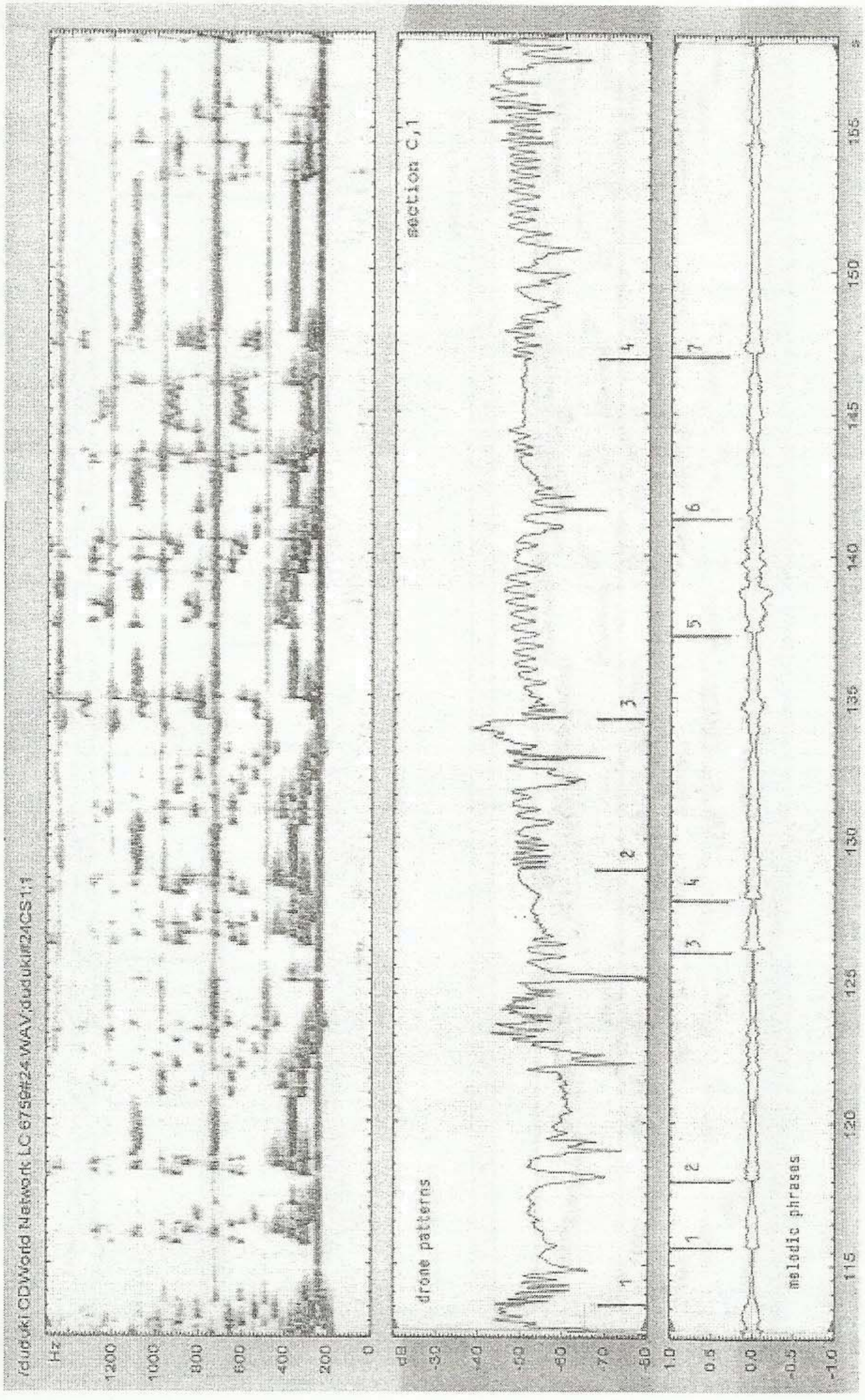
FIGURE 14.



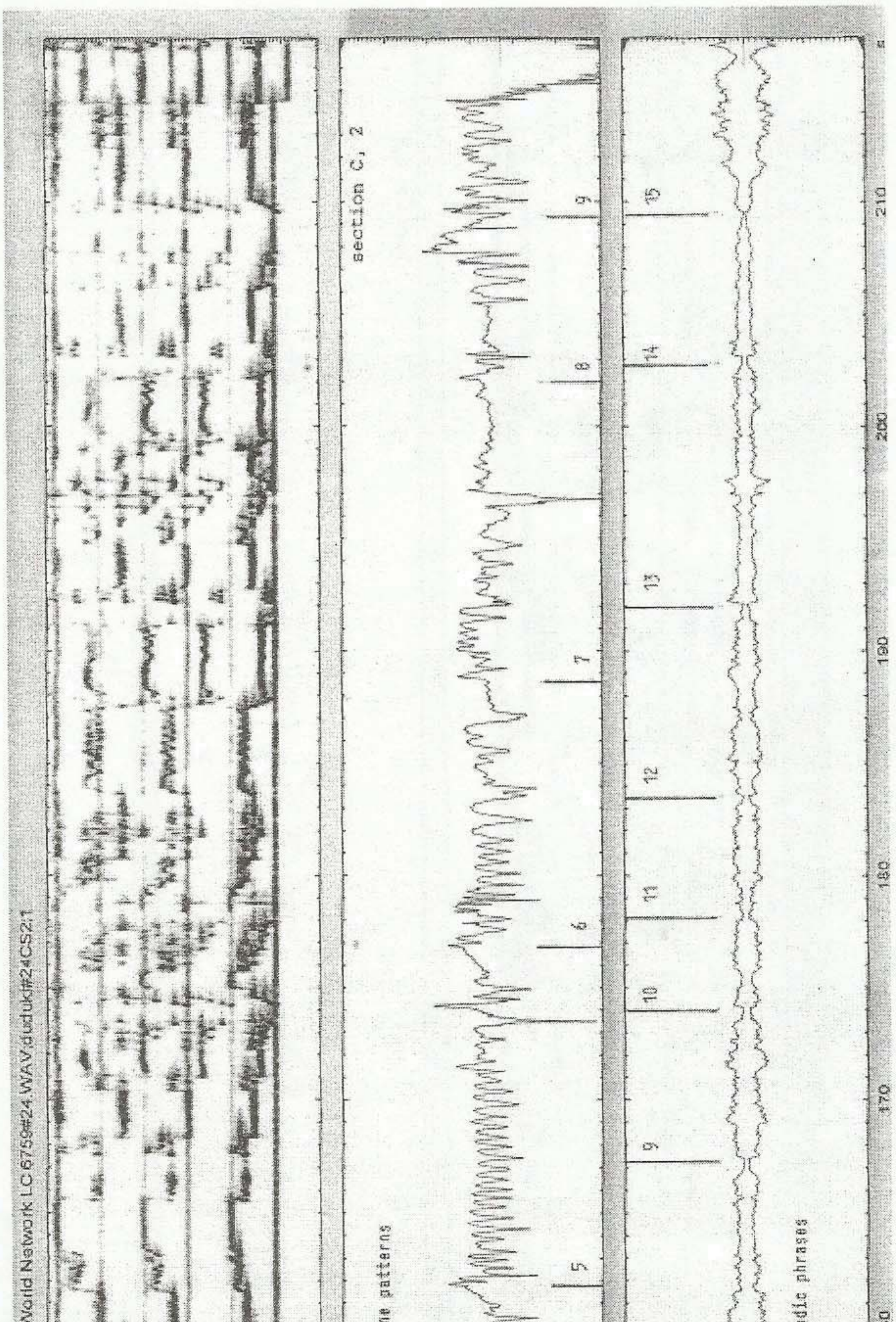


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FIGURE 15.

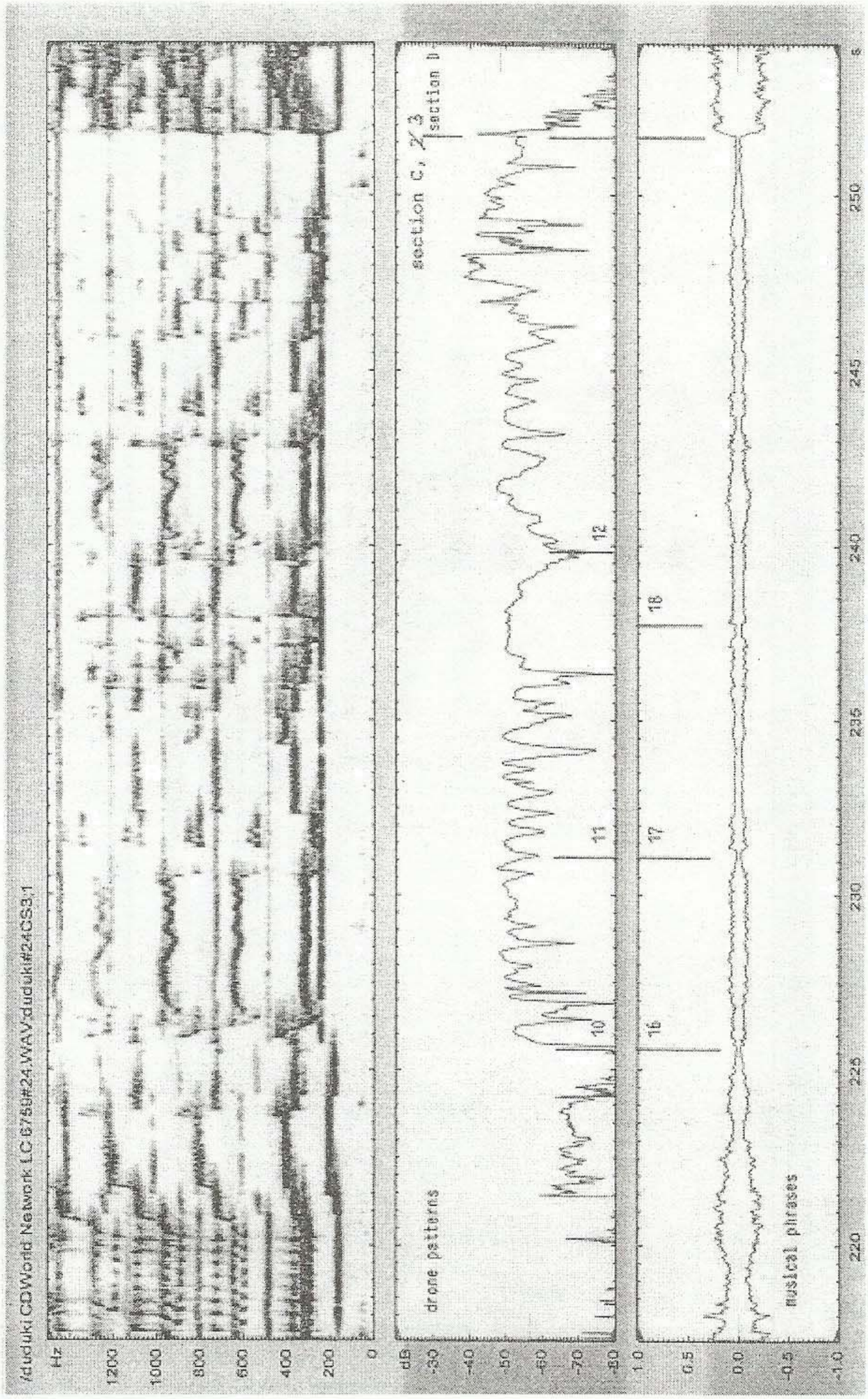

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FIGURE 16.

სურათი 17.
FIGURE 17.

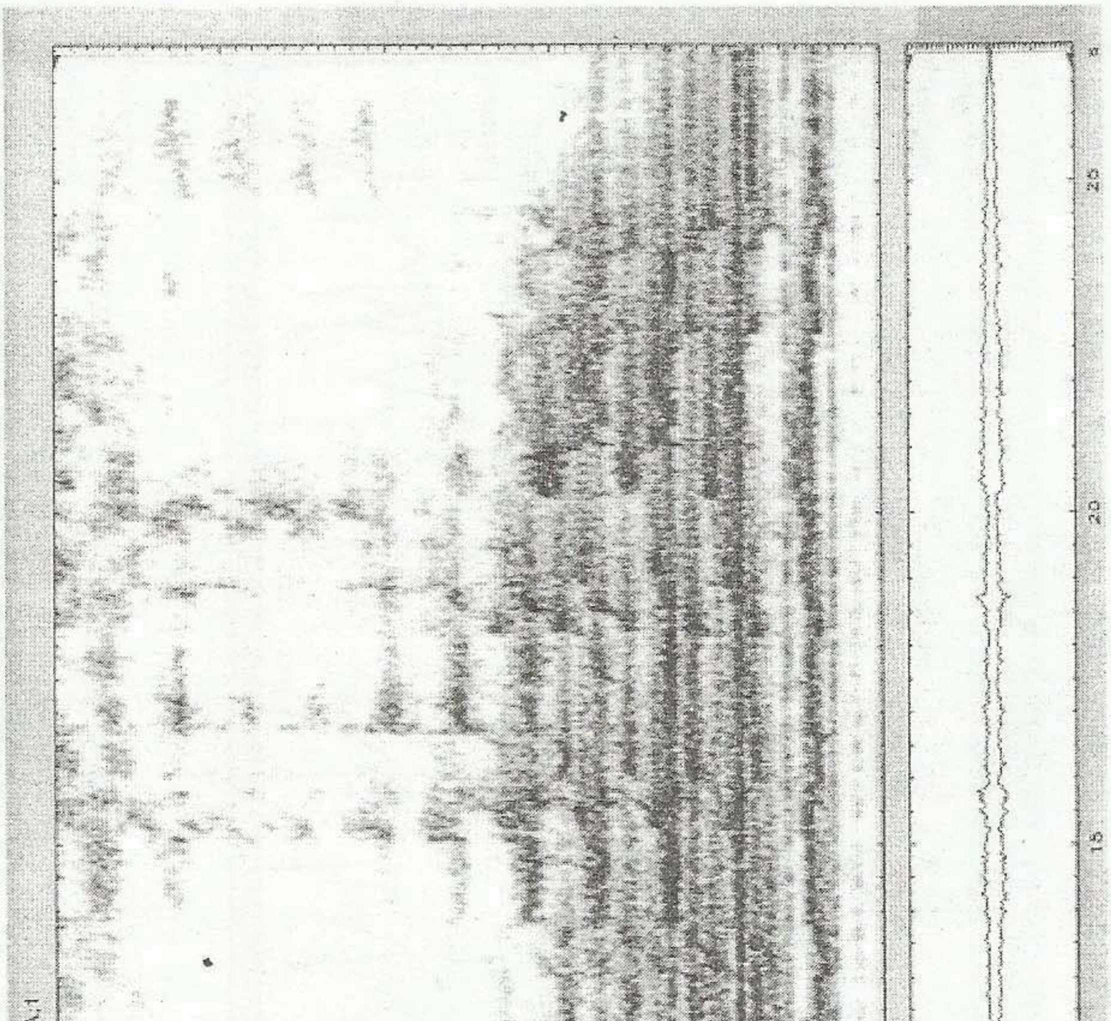

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FIGURE 18.

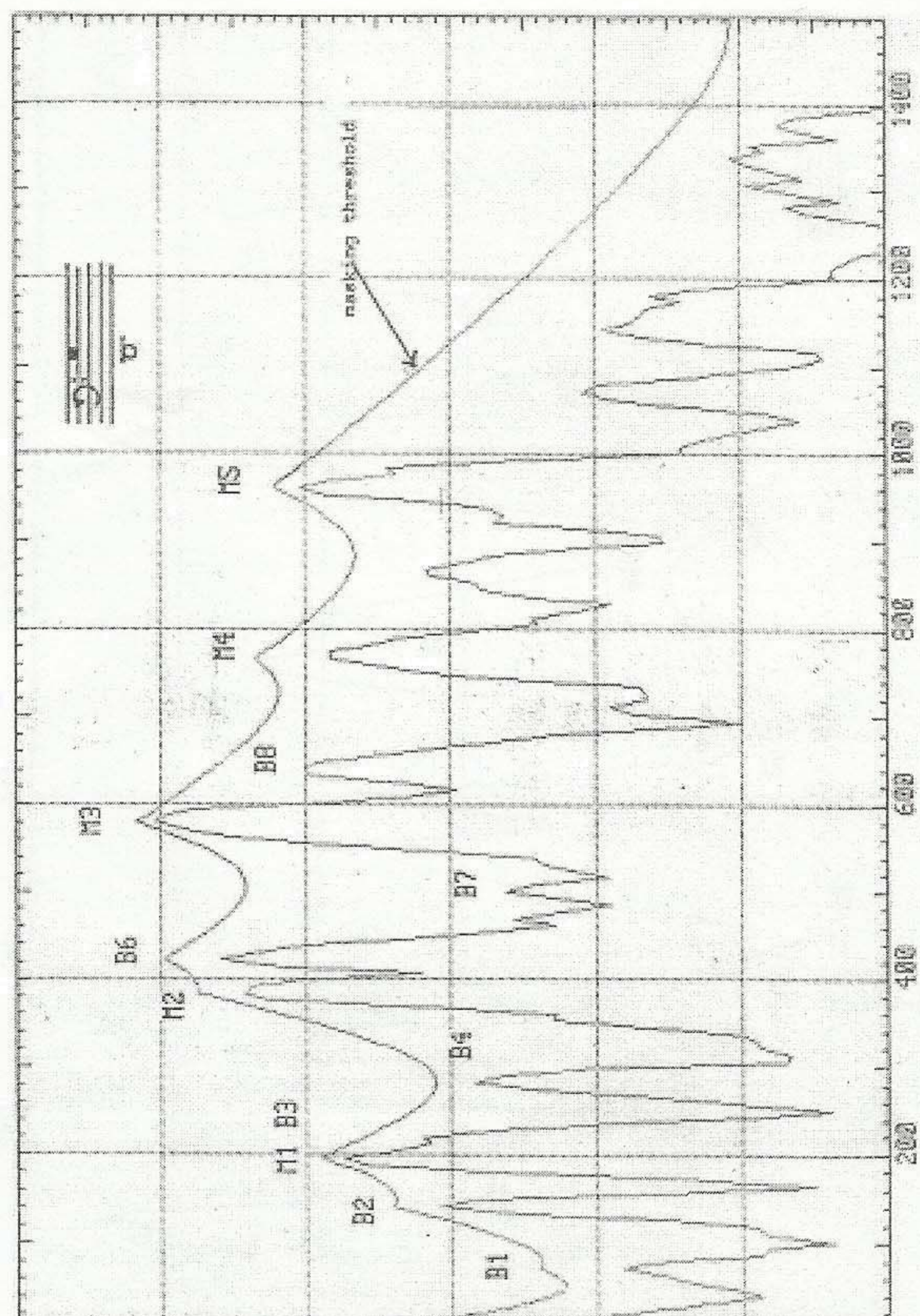

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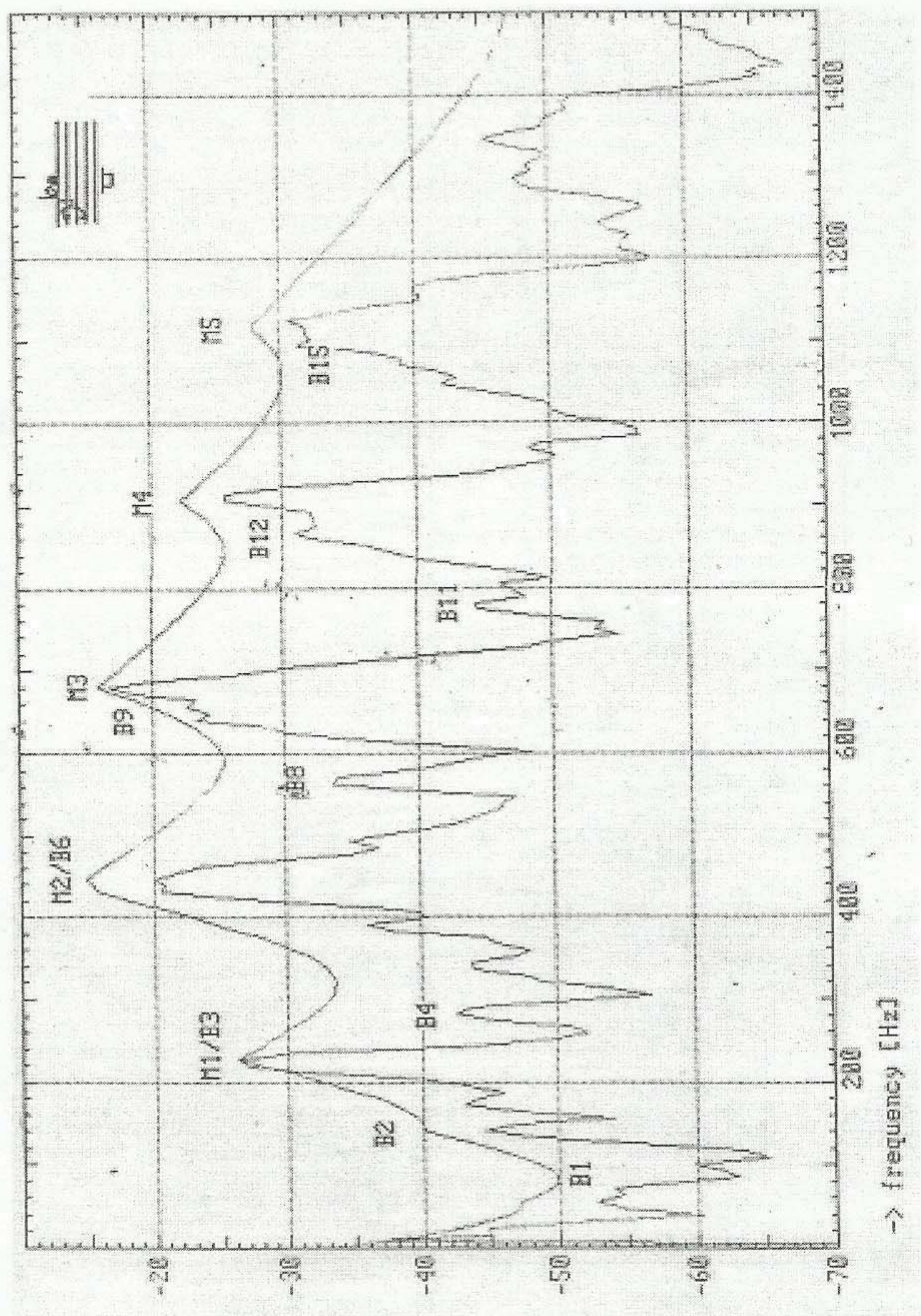
FIGURE 19.



სურათი 20.
FIGURE 20.