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## Georgian Complex Segments

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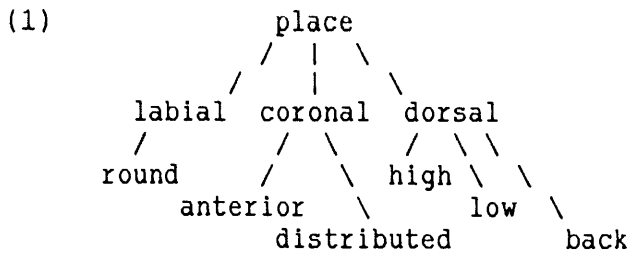
## GEORGIAN COMPLEX SEGMENTS

Viviane Deprez

MIT

The complexity of Georgian onsets, allowing up to 6 consonants preceding the nucleus (p'rckna : to peel) presents a challenge for recent theories of syllable structure. In this paper, I will argue that certain groups of obstruents in Georgian are better analysed as Complex segments that is as simultaneous constriction at different points of articulation linked onto a single timing slot. I will review the properties of these groups and I will show that these properties are elegantly explained if we adopt the view that these groups are complex segments in the sense of Sagey (1986). Clement's (1985) hierachical organization of features provides a distinction between class nodes which represent groups of features and terminal nodes which represent individual features. On the basis of this distinction Sagey (1986) has argued for the existence of articulator nodes viewed as class nodes. She proposes that the place node is subdivided into three subconstituents, each corresponding to a different active articulator: the coronal node , the dorsal node and the labial node.

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With Sagey's representation of articulator nodes given in (1), complex segments can be represented naturally as multiple specification for different articulators on the place node. Sagey points out that in the unmarked case complex segments are phonetically simultaneous and phonologically unordered. Contour segments like affricates or prenasalized consonants which are sequentially ordered strings of multiple specification for some terminal feature are represented as branching for one feature as in (2).



With these theoretical preliminaries in mind let us now turn to the study of Georgian Complex segments. The inventory of simple consonants in Georgian is given in (3):

	labial	coronal		dorsal	
		+ant	-ant	+high	-high
	labial	dental	palatal	velar	uvular
Stop	voiced	b	d j	J	g
	aspirated	p'	t' c'	C'	k'
	glottalized	p	t c	C	k q
Fricative	voiced		z	Z	Y
	voiceless		s	S	x
nasal		m	n		
liquid			r l		
glide		w/v			

Note that there is a gap in the stop paradigm. There are no voiced or aspirated uvular stops in Georgian. On the other hand, the only fricatives aside from the uvular are the dental fricatives, the unmarked type of fricatives. It would be unusual if Georgian had in addition to this unmarked fricative class just uvular fricatives. Since as argued by Vogt (1958), the uvular fricatives never pattern differently from the stops, I will assume that they are the phonetic realisation of the phonological aspirated and voiced uvular stops. The stop paradigm is thus complete.



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## 1 Corono-dorsal complex segments

### 1.1 Homogeneity of laryngeal features

The first striking property of the [corono-dorsal] groups is that they are homogenous in their laryngeal specifications. Both members of the cluster are either voiced, aspirated or glottalized. For this reason, these consonantal groups have been called harmonic groups in the traditional literature on Georgian (Vogt 1958, Tschenkeli 1958). If the first member of the group is either voiced aspirated or glottalized the second term always agrees with the first member in laryngeal features. There are no exceptions to this generalization in [corono-dorsal] groups. Thus clusters such as those given in (6) never occur in Georgian:

(6) \*[coronal dorsal] : t'k c'k    \*[coronal dorsal] : dk' jk'  
           asp        glot                                    voiced asp

          \*[coronal dorsal] : tk' ck'    \*[coronal dorsal] : dk jk  
                   glot asp                                    voiced

Note that homogeneity in laryngeal specification is not required in groups where the order of the articulations is reversed as in the [dorsal coronal] groups of (7):

(7)a. [dorsal coronal] : kc':[kc'ena] to blow  
           glot asp        : kt':[mkt'olvare]  
           asp glot        : xt: [xtoma] to jump to leap  
           asp voiced    : xd: [xdoma] to become

More generally, homogeneity in laryngeal specification although possible is not required with any other obstruent clusters as shown in (8):

(8)b. [coronal labial]  
           asp voiced        t'bilisi : tiflis capital of Georgia  
                                   tba: lake

          [coronal coronal]  
           c'da: attempt

Thus harmonic groups contrast with other clusters with regard to this property.

### 1.2 Sharing of closure and release

A second property of harmonic clusters is that the closure and release of their component members are essentially simultaneous. Many authors have noted this phonetic characteristic: (9)

" Die physiologische Besonderheit der Aussprache von harmonischen Komplexen besteht darin, daß sie ein gleicher Weise wie ein Einzelkomplex vermittels einer einziegen Implosion und Explosion



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dok.tan: a damm  
 bod.be: a village (S.Zgenti)  
 di.rek.to.ri: director  
 ak.to.ri: actor  
 ek's.plo.a.ta to.ri: exploiter (Robins and Waterson)  
 cin.swla: progress  
 sax.li: house  
 mar.cwali: syllable  
 mart'l.c'era: orthography (K.Tscenkeli)

## 1.5 Stem final consonant clusters

Another striking property of the harmonic groups is that they are the only obstruent groups to appear in stem final position. No other stop cluster is attested in that position. Assuming that harmonic clusters have the value of a single consonant, the final codas can be described by the template given by Vogt, reproduced in (13) and illustrated in (14):

(13) (In this template, O stands for obstruent,  
 S for sibilant ,R for sonorant.)

R - | O S | - R - (R)

| O |

(Vogt 1958)

(14) [bertq] to dust  
 [varcxn] to comb  
 [vicq] to forget

## 1.6 Clusters with three stops

In addition to onsets containing two stops, Georgian has also few onsets which contain three stops. Interestingly all the three stop onsets always contain a harmonic group of the [coronal dorsall] type . That is, they are always of the form given in (15) and illustrated in (16):

(15) X [coronal dorsall]  
 [coronal dorsall] X

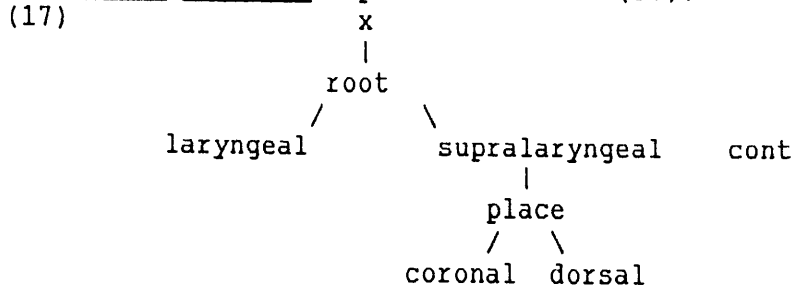
(16)a. labial [coronal dorsall]      b.[coronal dorsall] labial  
 [ptqeli] [bdYdiali] shine      [tkbili] sweet  
 [pckena]

b. [coronal dorsall] coronal      c.dorsal [coronal dorsall]  
 [v-cqd-ebil] I am broken      [gJYarbil] prokupine

Let us summarize briefly: I have shown that [corono-dorsall] groups manifest four basic properties: they are homogeneous as to laryngeal features, they show roughly simultaneous closure and release they cannot be separated by an intrusive r and they appear

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to pattern like single consonants with respect to Georgian phonotactics. To provide an explanation for these basic properties I propose that the [corono-dorsal] Harmonic groups be interpreted as complex segments represented as in (17):

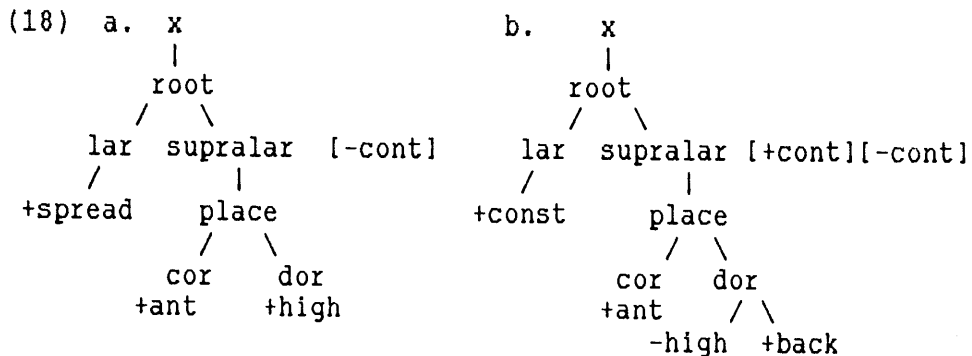


The cluster of properties distinguishing harmonic [corono-dorsal] segments from other clusters receive an immediate explanation under the hypothesis represented by (17). Homogeneity in laryngeal feature is expected since the two articulator nodes share a single set of laryngeal specification. Similarly, the fact that they have roughly simultaneous closures and releases can be taken as a phonetic indication of timing unity. Non-separability by *r* and the fact that [corono-dorsal] are tautosyllabic in word medial position are also expected since we are dealing with a single segment. The fact that complex segments are linked to a single *x*-slot also explains the presence of [corono-dorsals] in a single consonant position such as the stem final position. A final consequence of the hypothesis that Georgian corono-velar harmonic groups are complex segments is that the three stop clusters of (17) can be reduced to the more common two stop clusters already encountered.

Assuming that the basic structure of Georgian complex segments is as in (17), variation in feature specification under the laryngeal, coronal and dorsal class nodes are expected to produce a number of possible combinations. The list given in (4) shows that Georgian complex segments instantiate an impressive number of these combinations, due to their variations in laryngeal and continuancy features. To illustrate, complex segment like *t'k'* or *cq* will have respectively the representations given in (18) a. and b.:



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Segments like *cq* in (18b) containing as a first member an affricate are multiply specified both under their place node and on the single tier of continuancy. In Sagey's terminology, they are both complex and contour segments. The question arises then as to how specification for degree of closure is to be associated with a given articulator. Sagey (1986) proposes that in complex segments there can be only one distinctive degree of closure. The degree of closure of the second articulation is given by redundancy rules. At first sight however, Georgian complex segments are apparent counterexample to Sagey's proposal. Indeed if we look at the [coronal uvular] segments repeated in (19), we observe a variation in degree of closure for both the coronal and the dorsal articulator.

(19)a. [tq] b. [cq] c. [Cq] d. [t'x] e. [c'x] f. [C'x] g. [dY]

The coronal articulator can be [-cont] as in (19a). or [+/- cont] as in (19b). The dorsal articulator can be [-cont] as in (19a) or [+cont] as in (19d). Variations of continuancy do not occur in [corono-velar] segments where the velar components is always invariably [-cont]. Recall however, that I have assumed earlier that the uvular fricatives were the phonetic realisation of the voiced and aspirated uvular stops. Complex segments provide support for this assumption. Indeed, voiceless uvular fricatives only occur with aspirated coronal and voiced uvular fricatives with voiced coronals. The parallel with other harmonic groups suggests again that the [-cont] feature of the voiced and voiceless uvulars is non-distinctive. If the feature [-cont] is non distinctive for the uvular articulations, then Georgian complex segments are not a counterexample to Sagey's proposal for assignment of closure feature. Clearly, the degree of closure of the dorsal articulator can be taken as invariantly [-cont] and can thus be specified by redundancy rules. Georgian complex segments are thus compatible with Sagey's proposal.

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## 2 Labio-dorsal complex segments

I will now turn to the other consonant groups which have particular properties, namely the labio-velar/labio-uvular groups. Most authors classify the labio-velar and uvular groups given in (5), among the harmonic groups. Although these groups share some of the properties of the [corono-dorsals], they do not share all of them. Consequently their status as complex segments is less clear. I will argue that [labio-velar] groups although possible complex segments must sometimes be treated as clusters.

The study of the [labio-dorsal] potential class of complex segments brings up the issue of Sonority Sequencing. Therefore, before turning to the description of their properties I will make some preliminary remarks about the relative Sonority value of Georgian segments. As observed by Selkirk (1984), in most languages, tautosyllabic clusters of consonants obey two tendencies: first, they tend to be of increasing sonority. Second they tend to have their members maximally differentiated. Following Steriade (1985), I will call the first tendency the Sonority Sequencing parameter (henceforth the SSP) and the second tendency the Local Peak parameter (henceforth the LPP).

(20) The Sonority Sequencing Parameter (SSP):

Sonority Peak within the syllable must be adjacent.

The Local Peak Parameter (LPP)

Every pair of segments must contain a sonority peak.

I tentatively propose the Sonority scale given in (21) for Georgian obstruents<sup>3</sup>

(21) (MSD = 1)	
p' k' p k q x	[-son, -cont, -voice, -cor]
t' t c' c C' C	[-son, -cont, -voice, +cor]
b g Y	[-son, -cont, +voice, -cor]
d j J	[-son, -cont, +voice, +cor]
s S	[-son, +cont, -voice, +cor]
z Z	[-son, +cont, +voice, +cor]

Given such a sonority scale, Georgian can be shown to observe the SSP but not the LPP. So while clusters of the type t'p' which violate the SSP never occur in Modern Georgian, clusters like t'b which observe it are attested as for instance in the previously mentioned word *tbilissi*. (22) gives examples of clusters which respect the SSP:

(22) [t'blissil]: capital of Georgia

[p'tulil]: fruit [xbo]: calf [kbilil]: tooth

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[tbal]: lake [c'dal]: attempt [qbal]: jaw  
 Clusters violating the LLP although quite rare, can be found in common word of Modern Georgian. Others according to Vogt are quite archaic.

(23)[jdomal]: sit [ctomal]: to make a mistake  
 [gbobal]: to cook. (archaic)

4. Some support for the hypothesis that the SSP but not the LPP applies to Georgian tautosyllabic onsets comes from restrictions on the three stop clusters given earlier in (16). Vogt (1958) noted the fact that there is a gap in the distribution of the three stops clusters:

(24) a. coronal[corono-dorsal]  
 b. [corono-dorsal] dorsal

The type of clusters given in (24) are attested neither in old nor in modern Georgian. Our hypothesis about sonority sequencing in Georgian provides an explanation for this fact. But before outlining this explanation we must answer the question of how complex segments are to be taken into account for the computation of relative sonority. In other words, where do they belong in the table given in (25). I suggest the following:

(25) If some sonority restriction R applies  
 in some language L1, R will apply to both  
 members of a complex segment.

With this assumption, we can now see why the clusters of (24) are excluded. Let us look for instance at (24a): the copresence in an onset of the coronal segment with the coronal member of the complex segment would violate the LLP, but as we have seen this is acceptable in Georgian; but the copresence of the coronal segment with the dorsal member of the complex segment violates the SSP. Since one of the member of the complex segment violates a sonority restriction which is applicable in the language, (24a) is thus excluded by (25) as a possible onset of Georgian<sup>5</sup>. The same reasoning applies to (24b.). Turning to the clusters given in (16) however, we can see that none of them violates the SSP. This is why they are acceptable. Consider (16b): the dorsal labial relation meets the SSP (although not the LPP). The coronal labial relation meets the SSP since the coronal member is voiceless and thus less sonorous than the voiced labial. Therefore this group is a possible onset in Georgian<sup>6</sup>.

With regard to complex segments, my hypothesis on Sonority Sequencing in Georgian has the following consequences. Since syllabic constituents are constructed on x-slots and not on skeletal units, if coronal dorsal groups were tautosyllabic clusters of segments, each with their own x-slot as represented in (26a), they would violate the Sonority Sequencing tendency. The hypotheses that harmonic groups are linked to a single x-slot avoids this problem: indeed syllable containing [corono dorsal]

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segments in their onset, as represented in (26b) have the same template as those containing a simple segment.



On the other hand, if labio dorsal harmonic groups were interpreted as clusters, they would violate only the LLP and this, we know, is acceptable. As I will argue, this may be the source of the difference of patterning between [corono-velar] complex segments and [labio-velar] harmonic groups. I will now turn to a description of the properties of labio-dorsal harmonic groups.

### 2.1 Homogeneity of laryngeal features

Although most authors classify labio-dorsals as harmonic groups, Vogt mentions some exceptions to the homogeneity in laryngeal specification in these clusters. Some groups where the labial segment is voiced and the dorsal segment is either aspirated or glottalized are attested in modern Georgian. But as examples in (27) show, these non-harmonic groups always alternate with harmonic aspirated or glottalized groups.

(27)a. [voiced aspirated]  
       bx: daa-bxavina    root= p'xvan  
       bk: caa-bkvia     root= p'kveva.

b. [voiced glottalized]  
       brke/ prke :mold  
       brkoleba /prkoleba : to prevent<sup>7</sup>

They are never distinctive and may thus be treated as phonetic variants of the harmonic aspirated and glottalized groups. Vogt draws support for this assumption from phonetic facts. He mentions that in groups of two aspirated or glottalized stops the aspiration or the glottalisation of the first member of the group is sometimes so weakened that they become indistinguishable from the voiced obstruent. 8. The non-distinctiveness of these variants is also reflected in the written language by spelling variations. Following Vogt, I will then assume that the groups in (27) are phonological instances of Harmonic groups. As it was true for the [coronal dorsal] groups, homogeneity in laryngeal feature is not required if the articulation are in the reverse order namely, [dorsal labial]:

(28) [dorsal labial] : xb: [xbo] calf

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asp      voiced

Note that the clusters in (28) conforms to the sonority scale.

## 2.2 Sharing of release and closure

With regard to simultaneity of closure and release, [labio-dorsal] groups pattern like [corono-dorsals]. The remarks made on the simultaneity of closure and release for [corono-dorsal] complex segments apply equally to [labio-dorsal] harmonic groups. All the authors mentioning this property included both types in their remarks.

## 2.3 r intervention

With regard to the phenomenon of r intervention [labio-dorsal] harmonic groups differ from [corono-dorsal] group. Some cases of [labio-dorsal] groups separated with an r are attested in modern Georgian . Interestingly, Vogt notes that while the presence or the absence of an intervening r seems to vary freely in other clusters, it appears to be lexically determined for [labio-dorsal] groups. That is, words containing [labiodorsal] groups separated with an r never have a variant without, and vice-versa, word attested without an r never allow it as is shown in (29) :

- (29)a. [brge] of high size      \*[bge]  
       [brgu] stuttrerer        \*[bgu]  
       b. [brgeral] sound        \*[brgeral]  
       [prkurebal] to disperse    \*[prkurebal] (Vogt )

Vogt mention that in cases (29)b the absence of r between the two stops could be due to its presence before the vowel. Indeed even in other obtruent clusters, r never separates the obtruent if there is an r preceding the vowel of the same syllable. Although Vogt does not give any other example, his assertion that the presence of r is lexically determined in [labio-velar] groups is meant to be general: "La parenthese (r) qui apparait dans le tableau veut dire que le groupe est atteste avec et sans la sonante. Mais a la difference des groupes examines ci-dessus, il n'y a pas ici d'alternance libre entre les formes sans r et les formes avec r, les mots en questions sont attestes sous l'une ou l'autre forme." (Vogt 1958 p36)

## 2.4 Syllabification

With regard to syllabification properties, [labio-velar] groups are parallel to [corono-dorsal] groups. Indeed, both Tschenkeli and Zgenti who noted the fact that harmonic groups cannot be heterosyllabic include [labio-dorsal] groups in the

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class of harmonic groups. The following examples are given by Zgenti:

(30) a.bga	*ab.ga	
na.bgi	*nab.gi	(S.Zgenti (1965))

## 2.5 Final clusters

Similarly to [corono-velar] complex segments, some labio-velar groups are attested in stem final position. Vogt notes the occurrence of the labial groups given in (31) but he gives only one example:

(31) p'k' ,pk, p'x pq  
apk-s : membrane (dative)

Clearly, although some [labio-dorsal] groups occur in stem final position they are much less frequent than [corono-dorsal] groups.

## 2.6 Three stop clusters

No labiodorsal groups are ever members of three stop clusters. No labial velar coronal three stop clusters is attested.

If [labio-dorsal] are interpreted as clusters, their simultaneity of closure and release as well as their phonotactic properties such as the fact that they are tautosyllabic and the fact that they occur in stem final position seem hard to explain. On the other hand if they are always interpreted as complex segments just as the [corono-dorsal] segments, the fact that r intervention is sometimes allowed remains mysterious. I propose an intermediate solution, namely that the [labio dorsal] groups are sometimes interpreted as underlying complex segments and sometimes as underlying clusters. I take the occurrence of complex segments versus clusters to be lexically determined. This hypothesis is somewhat supported by the r intervention facts. Indeed if as Vogt asserts it is true that r intervention for [labio dorsal] groups is lexically determined, this can be easily explained as follows: labio-dorsal groups which surface with an r must be considered as clusters. On the other hand, labio-dorsal groups which do not allow r intervention may be the realisation of underlying complex segments. The proposal that the occurrence of labio-velar complex segments versus cluster is lexically determined makes two predictions: first some labio-dorsal clusters must show non simultaneity of closure and release. Second some word medial labio-dorsal sequences could be heterosyllabic. So far I have not found supporting evidence for either of this prediction. Note that if no labio-dorsal heterosyllabic sequences could be found this would not necessarily disconfirm my hypothesis. It is conceivable that all word medial [labio-dorsal] groups are complex segments. Possibly we would then be dealing with derived complex segments.

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If so, I would propose the following analysis. Although as I have conjectured earlier, the LPP can be violated in stem initial onsets, I would assume that it cannot be violated in word medial cluster. One strategy to prevent this violation would be a rule of complex segment formation which would apply before syllabification. As a consequence, although labio-dorsal harmonic group in stem initial position could be either clusters or complex segments on the basis of lexical distinction, word medial labio-dorsal harmonic groups would always be complex segments.

### 3 Conclusion

Let us conclude briefly: I have shown that the coronal dorsal harmonic groups of Georgian and some labio-dorsal groups must be analysed as complex segments. With this assumption, I have been able to propose a sonority scale for Georgian and to state some sonority restriction on the possible clusters of Georgian. This suggests that the syllable structure of Georgian might be simpler than previously thought. My analysis of complex segment in Georgian also provides support for the theory of Complex segments proposed by Sagey (1986).

### -- Notes --

1. see also Axvlediani 1949: 105 and Gamkrelidze, Macavariani 1982

2. Apparently, the simultaneity of release is not always present in Georgian. Cf Robins and Waterson "Notes on the Phonetics of the Georgian Word". Contrary to the previously mentioned studies, Robins and Waterson's study does not concentrate on harmonic groups. It was made on one speaker born in Kutais (West-Georgia) so that it may well be that the observed difference is a case of dialectal variation.

3. This sonority scale does not include sonorants. Indeed sonorants contrary to stops appear to violate the SSP. However, there are arguments supporting the hypothesis that liquids and "r" in particular can be syllabic

4. Full justification of our proposed sonority scale and of its consequences for the interpretation of Sonority sequencing in Georgian cannot be undertaken here Cf Deprez 1986 for a more detailed study. The complete inventory of Georgian stem-initial and stem-final clusters on which the proposed sonority scale is based can be found in Vogt (1958)

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5. Clearly in this case, the violation of the SSP could not be compensated by a complex segment formation. A complex segment could not by definition have a multiply specified dorsal node

6. Note that as predicted, three stop clusters with a coronal-dorsal segment followed by a labial, where the labial has the same laryngeal specification as the [coronal-dorsal] segments, as for instance \*tkp 't'k'p' do not occur in Georgian, since they violate the SSP.

7. Vogt notes: "en effet, dans les mots attestés, il y a flottement constant entre la sourde aspirée initiale et la sonore - il n'y a jamais d'opposition phonémique entre les formes a sonore initiale et celles a sourde aspirée... La même chose se constate pour certains d'entre les groupes sonores glottalisés (labio dorsal)" (Vogt p48)

8. This view is also supported by the phonetic studies of Robins and Waterson p66)

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