Elizabeth Hall. 2014. *An Analysis of Muak Sa-aak Tone.*
Journal of the Southeast Asian Linguistics Society (JSEALS) 7:1-10
Received 13/6/13, revised text accepted 25/3/2014, published April 2014.
URL: http://hdl.handle.net/1885/11557
ISSN: 1836-6821 | Website: http://jseals.org
Editor-In-Chief Dr Paul Sidwell | Managing Editor Dr Peter Jenks

Asia-Pacific Linguistics
SOUTHEAST ASIAN LINGUISTICS SOCIETY SEALS
www.jseals.org | Volume 7 | 2014 | Asia-Pacific Linguistics
Australian National University

AN ANALYSIS OF MUAK SA-AAK TONE

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Abstract
Muak Sa-aak is a tonal Angkuic language spoken in Eastern Shan state of Myanmar, belonging to the Austroasiatic family. It has three contrastive tones: a falling tone, a low tone, and a constricted tone with two allotones. Syllable structure and tone are closely linked, seen by restrictions on the occurrence of tones with certain syllable structures. Angkuic languages do not appear to develop tone through the loss of an initial consonant voicing distinction, as they instead underwent a shift where proto-voiceless initial tenuis stops became aspirated and proto-voiced consonants were devoiced (Svantesson 1988); it instead is connected with vowel length contrast (Svantesson 1988, Diffloth 1991). None the less, Muak Sa-aak preserves vowel length contrast despite the development of tone. It is argued that Muak Sa-aak tonogenesis is motivated by both vowel length and final consonants.
Keywords: Palaungic, Angkuic, tone, tonogenesis
ISO 639-3 codes: tlq, mqt, mmt, uuu, huo

1. Introduction

Muak Sa-aak is a tonal Austroasiatic language, belonging to the Angkuic subgroup of the Eastern branch of the Palaungic languages, a subgroup of Austroasiatic. Speakers of Muak Sa-aak are found in Eastern Shan State of Myanmar, and in China, with an estimated population total of over 4,000 (Hopple 2007). Angkuic also includes languages such as Hu, U, Mok, and Man Met. Other Angkuic languages are known only from early twentieth century wordlists. The group includes both tone and non-tone languages. Unlike the tonogenetic mechanisms described for other Austroasiatic languages, Angkuic tone development has been linked to a loss of vowel length contrast, rather than to a merger of initial consonant voicing distinctions.

The development of tone in Austroasiatic languages has been linked to both initial consonant voicing distinctions and to loss of final consonants (cf Haudricourt 1954, Matisoff 1973, Huffman 1976, Thurgood 2007, etc). In Khmu for example, the merging of voiced and voiceless initials has resulted in the development of a binary tone contrast in some varieties, and of a binary phonation contrast in others (Suwilai 1999, 2001, Svantesson 1989), where words with proto-voiced initials result in low tone or breathy voice. Proto-voiceless initials are reflected in high tone or modal voice.

In exploring the development of tone, Matisoff (1973), the first to use the term "tonogenesis," bases a term "tense larynx syndrome" opposing a "lax larynx syndrome," on a combination of particular features. Tense larynx features include high pitch or rising contour, final glottal stop, voicelessness, creaky voice, and reduced supraglottal cavity indicating a raised larynx. Lax larynx features comprise low pitch or falling contour, final glottal fricative, voicing, breathiness, and increased supraglottal cavity, indicating a lowered larynx (Matisoff 1973). Initial voicing distinctions tend to affect the actual pitch of the following vowels, and final consonants types appear to cause either rising or falling pitch contours. While these microprosodic effects are universal, Matisoff suggested they only produce tone in monosyllabic languages. This is a feasible explanation due to the tightly structured nature of the syllable in these languages, where the different parts of the syllable closely affect each other. Accordingly, Thurgood (2007) emphasizes laryngeal over segmental configuration in Vietnamese tonogenesis and argues that it is not directly the loss of onset voicing

distinctions that leads to tonogenesis, but an intermediate stage of suprasegmental distinctions including phonation and pitch. The resultant pitches correspond to consonant features rather than to specific consonants, suggesting that it is the laryngeal configuration driving tonogenesis. He similarly links the development of tones not to just final stops but the accompanying glottal closure, since final voiceless stops in Southeast Asian languages are frequently glottalized. Therefore it is the accompanying laryngeal features of both that result in pitch distinctions. Since initial voiced sonorants do not seem to affect tone and phonation in the same way as voiced stops, the manner of articulation and accompanying aerodynamic properties rather than just the presence or absence of vocal fold vibration appear to have an impact on the development of contrastive pitch (Thurgood 2007). Phonetic explanations of tonogenesis support both the development of low tone from voiced initial plosives, and contours arising from final glottal stops and fricatives (Hombert et al. 1979, Henderson 1982).

The results of a shift from a former initial consonant voicing contrast to either phonation, tone, or a vowel split (Huffman 1976, Suwilai 1999, 2001, Thurgood 2007, Abramson 2004) in Austroasiatic languages is commonly referred to as register. This has also been observed in the Austronesian Chamic languages following their long contact with Austroasiatic (Thurgood 1996). A fourth and less well-known possible reflex of the Austroasiatic initial consonant voicing contrast is the development of contrastive aspiration found in the Angkuic sub-branch. These languages are also marked by retention of the proto-Austroasiatic distinction between initial **s* and **h* (Diffloth 1977, Svantesson 1988, 1989, 1991). As seen in Table 1, the former initial consonant voicing distinction is retained as an aspiration contrast for the Angkuic languages Muak Sa-aak, Hu, and U, and Mok. Another Palaungic language, Lamet, reflects this contrast through phonation. Note that Lamet still displays the proto-Palaungic length distinction which led to the development of tone in Hu and U, as will be discussed later in depth. Accent marks denote tone in Muak Sa-aak, Hu and U but voice quality in Lamet.

Muak Sa-aak[1]	Hu	U	Mok	Lamet	Gloss
pôl		*pó*	*səpoː*	*pòːr*	‘evening’
pʰɤ̂n	*phín*	*phàt*	*phən*	*rmpín*	‘woman’
p.tàːk	*phltàk*	*ʔatăʕ*[2]		*pltàːk*	‘palm of hand’
tʰàːk	*nthàk*	*nthăʕ*	*thaːk*	*pltáːk*	‘tongue’
kâːŋ	*kàŋ*	*káã*[3]	*kə-kaːŋ*	*kàːŋ*	‘house’
kʰɛ̂ŋ	*khíŋ*	*ŋkhèt*	*kheŋ*	*kɛ́n*	‘tooth’

Table 1: Reflexes of former initial voicing distinction in five Palaungic languages (based on Hall 2010, Svantesson 1988, 1991)

If a former voicing distinction had been the driver of registrogenesis in Angkuic, the initial voiced and voiceless consonants in languages like Muak Sa-aak, U, Hu and Mok should have merged, and tone or phonation would contrast instead. Since the proto-voicing distinction led to aspiration contrast in Angkuic languages, tone must therefore be linked to a different mechanism, namely the loss of vowel length contrast attested for Hu and U. Tonal development in U is complex because it also involves consonant types, but Hu high and low tones directly correspond to historical vowel length, with low tone corresponding to historically long vowels, and high tone corresponding to historically short vowels (Svantesson 1988, 1991). Only the Angkuic languages which lack contrastive vowel length developed a pitch contrast, while the non-tonal language Mok retains vowel length contrast. Muak Sa-aak does not follow either pattern; it shares the Angkuic aspiration contrast seen in Hu, U, and Mok, but it developed tone like Hu and U while retaining contrastive vowel length like non-tonal Mok. The retention of both long and short vowels in Muak Sa-aak therefore results in a doubled vowel inventory of eighteen vowels compared to the other tonal Angkuic languages Hu and U with only nine vowels (Svantesson 1991, 1988). This phenomenon of vowel length retention in a tonal Angkuic language contradicts Svantesson’s proposed tonogenetic mechanism of vowel

[1] For ease of comparison, tones are marked with accents in this chart; elsewhere they are marked with numbers.
[2] /ʕ/ symbolizes a pharyngeal approximant rather than a fricative; it denotes the reflex of /*-k/.
[3] /ã/ symbolizes a nasalized vowel; it denotes the reflex of /*-ŋ/.

length contrast turning into tonal contrast in Angkuic (1988, 1991). Other mechanisms for tonogenesis in Muak Sa-aak must therefore be explored.

A further puzzling feature of Muak Sa-aak is that its vowel length contrast is complete, even though length distinction for the high vowels /i, u/ appears to have been lost in proto-Angkuic (Svantesson 1988), because high vowels in both Hu and U have the same tone regardless of the historic vowel length. The non-tonal Angkuic language Mok also retains contrastive vowel length only in non-high vowels, and despite the development of tone, Muak Sa-aak appears to be more conservative in this respect. It may be possible that Muak Sa-aak represents another Angkuic subgroup: the development of tone cannot be linked to loss of vowel length contrast, and its fully retained vowel length contrast makes Muak Sa-aak even more conservative in this respect than the non-tonal Mok, with its reduced vowel length contrast. While this hypothesis cannot be explored in depth due to lack of data from related languages, this paper focuses on the Muak Sa-aak tonal system and its relationship to syllable structure and other possible mechanisms involved in the development of tone. Following an overview of the segmental phonology an analysis of tone and its relationship to syllable structure will be presented. This will reveal that tonogenesis appears to be influenced by final consonants and syllable structure, similarly to U, as well as to vowel length as reported for U and Hu. The resulting conclusions regarding tonogenesis and a summary will be given in the final part.

2. Muak Sa-aak phonology

Muak Sa-aak has 21 consonants and 18 vowels (Hall 2010). There are mono-and sesquisyllabic words and multi-syllabic compounds. Full-syllable onsets are comprised of single consonants and clusters formed by voiceless bilabial and velar stops followed by the rhotic or the labiovelar approximant /pr, kr, p^hr, k^hr, pw, kw, p^hw, k^hw/. Codas are limited to unreleased voiceless stops /p, t, c, k/, nasals /m, n, ɲ, ŋ/, and the approximants /w, j, l/. As an isolating tone language, Muak Sa-aak does not show inflectional morphology, and has a limited number of derivational prefixes, which are realized as minor syllables with neutralized vowel contrast. Minor syllable initial consonants are limited to /p, t, k, p^h, k^h, m, s/ and the clusters / p^hr, k^hr/. Since there appears to be a link between tonal development and syllable structure, this paper will distinguish between smooth syllables, comprised of open and sonorant-final syllables, and checked syllables, referring to stop-final syllables.

The 21 consonant phonemes include four aspirated and four unaspirated voiceless stops, with voicing contrast for the bilabial and alveolar place of articulation, four nasals, three fricatives and four approximants.

p^h p b	*t^h t d*	*c^h c*	*k^h k*
m	*n*	*ɲ*	*ŋ*
f	*s*		*h*
w	*r l*	*j*	

Table 2: Muak Sa-aak consonant phonemes

Since Muak S-aak has developed an aspiration contrast from the proto-voicing contrast, the bilabial and alveolar voiced stops should not exist. Many of these words appear to be loans from Tai Lue and their presence may be due to language contact.

The 18 vowels include 16 monophthongs and two diphthongs. Vowel length is contrastive for monophthongs. Diphthongs, found only in closed syllables, do not occur in every dialect. In Wan Fai Muak Sa-aak they appear to have replaced the long open front and back monophthongs /ɛː, ɔː/ found in other Muak Sa-aak varieties that lack diphthongs. In the Wan Fai variety these long open monophthongs rarely occur and are allophones of the diphthongs in open syllables.

i iː	*ɯ ɯː*	*u uː*
e eː	*ɤ ɤː*	*o oː*
ɛ ia	*a aː*	*ɔ ua*

Table 3: Muak Sa-aak vowel phonemes as spoken in the Wan Fai variety

A feature relating to syllable structure which will be further discussed below is that final sonorants are significantly lengthened following short vowels, such that regardless of vowel length, all sonorant-final syllables are phonetically long. Therefore, in this analysis, "long syllable" refers both to syllables containing a long vowel, with or without sonorant codas, and also to sonorant-final syllables with short vowels.

2.1 Tone

Tone in Muak Sa-aak does not seem to have a high functional load, as there are not many true minimal pairs found in the data. Only main syllables display tonal contrast. The four pitches may be grouped into three phonemic tones: a low level Tone 1, a constricted Tone 2 with high and high falling allotones, and a high-falling Tone 3. The term constricted follows Bradley's usage for stop final or laryngealized syllables (1977), comprising both creaky phonation and final glottal closure as described below. Not all syllable types occur with all three tones; pitch and phonation type is nearly predictable based upon syllable structure. It is smooth syllables carrying all three tones that require interpretation as a tone language.

In Muak Sa-aak, phonation is an accompanying laryngeal feature of tone, especially in words with long syllables, and shows a high degree of both intra- and interspeaker variation. Low Tone 1 has accompanying stiff voice. Constricted Tone 2 is realized with modal voice in short syllables and creaky voice in long syllables. Both falling Tone 3 and the long allotone of Tone 2 share the same high-falling pitch and are distinguished only by phonation: Tone 3 has modal voice, whereas the long allotone of Tone 2 is creaky with final glottal closure. For the short high-pitch allotone of Tone 2, constriction is realized with either stop finals or a phonetic glottal stop following short vowels in open syllables. This glottal stop appears to be a non-contrastive phonetic feature since it does not occur as a final in any other environment. Examples for tone are shown in Table 4.

Syllable type		Smooth				Checked	
Tone	Phonetic realization	sonorant-final long vowel	sonorant-final short vowel	open long	open short	long	short
1	low, stiff	*ra:ŋ¹* [rà:ŋ] abandoned'	*raŋ¹* [ràŋ:] 'rich'	*ci:¹* [cì:] 'sap'		*kʰa:p¹* [kʰà:p] 'chin'	
2	high modal (short)		*raŋ²* [râŋ:ˀ] 'fallow field'		*ci²* [cíʔ] 'do'		*kʰap²* [kʰáp] 'enough'
	high-falling creaky (long)	*ra:ŋ²* [rə̂:ŋ] 'separate'		*ci:²* [cə̂:] 'point'			
3	high-falling, modal	*ra:ŋ³* [râ:ŋ] 'flower'	*raŋ³* [râŋ:] 'shining'	*cu:¹ci:³* [cù: cî:] 'make a hole'			

Table 4: Minimal sets for Muak Sa-aak tone

The low tone marked as 1 occurs only in long syllables, with either long vowels or sonorant finals. Nasal finals are uncommon and the lateral approximant final is rare; these sonorants prefer the high-falling modal Tone 3. The palatal nasal final does not occur with this tone at all. Low Tone 1 is realized with stiff voice, a tight, tense phonation type which is in between modal and creaky voice[4]; the degree of tenseness varies. Examples for Tone 1 are *tʰa:kˀ¹* 'tongue', *t.lɤ:¹* 'lizard', *cʰa:j¹* 'sky', *li:¹* 'come out', *rɤ:m¹* 'fade'.

Constricted tone 2 occurs on all syllable types except long checked. It has two allotones in complementary distribution: high pitch on short syllables (non-sonorant final), and high falling pitch with creaky phonation on long syllables, which are rare and tend to be loans from Tai Lue, the main Muak Sa-aak contact language (see section 5.2 for further discussion). In smooth syllables this tone is accompanied by final glottal closure. Long vowels with constricted Tone 2 are slightly shorter than long vowels with low

[4] See Ladefoged and Maddieson (1996: 48-50) for further discussion of these voice quality types.

Tone 1 or falling Tone 3. Examples are *rɤp²* [rɤ́p] 'fishing net', *tʰi²* [tʰí?] 'arm', *cu:¹ ci:²* [cù:.cî:?] 'dung beetle', *ma:ŋ²* [mâ:ŋ?] 'spoil'.

Modal high-falling Tone 3 occurs only on long smooth syllables. The final palatal nasal /ɲ/ is restricted to this tone, which is also preferred by final /l/. Examples for falling Tone 3 are *kʰa:j³* 'eat', *t.po:l³* 'night', *p.sɤɲ³* 'snake', and *tʰu:³* 'apply'.

2.2 Correlation of syllable structure and tone

To summarize the above discussion of Muak Sa-aak tone, only smooth syllables display full tonal contrast. Low Tone 1 is limited to long smooth and checked syllables; falling Tone 3 occurs only with long smooth syllables. Constricted Tone 2 occurs with every syllable type and syllable length, except long checked syllables. For short open and checked syllables and for long checked syllables, pitch and phonation are predictable. These are clear distributional restrictions linked to syllable structure; the motivating factors appear to be syllable length and coda, as seen in Table 5. Under "Syllable type", P denotes plosives, S denotes sonorants.

Syllable type	**Tone 1** Low stiff	**Constricted Tone 2**		**Tone 3** High-falling modal
		High modal	High-falling creaky	
Short open (V) Short checked (VP)		X		
Long checked (VVP)	X			
Long smooth (VV, VS, VVS)	X		X	X

Table 5: Tones and allotones by syllable type

It is tempting to interpret the table above as Muak Sa-aak contrasting modal vs. constricted phonation, accompanied by high falling pitch in long smooth syllables; modal voice accompanied by high pitch in short syllables, and constricted stiff voice accompanied by low pitch in all types of long syllables. The problem here is that long smooth syllables have two different constricted realizations, one with low pitch and one with high-falling pitch. The next possible solution would be that Muak Sa-aak suprasegmentals might form a mixed, possibly transitional system, moving from phonation to tonal contrast with register contrast in long smooth syllables, and tonal contrast for all other syllables (cf Suwilai 1999, 2001, Huffman 1976). The fact that the high and low tone would be in complementary distribution, and smooth syllables have three laryngeal settings, namely low stiff or tense pitch, high or high-falling creaky pitch depending on syllable length, and high-falling modal pitch, favors the interpretation as a tonal system. Examples for the interaction between tone and syllable structure are seen in Table 6 below.

	Tone 1 (low)		Tone 2 (high constricted)		Tone 3 (high falling)	
CVS	*pɤl¹*	'fall'	*kan²*	'be defeated'*	*kam³*	'language'
CCVS	*kʰuːˑ³ kran¹*	'lazy'	*pʰrɤŋ²*	'bee'	*prɛŋ³*	'head'
CVVS	*kɤːn¹*	'before'*	*kuaŋ²*	'bottle'	*kaːŋ³*	'house'
CCVVS	*krɤːn¹*	'lying down'	*kʰruan²*	'gather'	*kriːl³*	'skinny'
CVP		--	*kat²*	'burn'		--
CCVP		--	*prɛt²*	'lick'		--
CVVP	*kaːt¹*	'fasten'		--		--
CCVVP	*t.pruːt¹*	'swallow'		--		--
CV		--	*ke²*	'they (3PL)'		--
CCV		--	*kra²*	'stir'		--
CVV	*keːˑ¹*	'pour'	*pɔːˑ¹ kaːˑ²*	'trader'	*kaːˑ³*	'pack (v)'
CCVV	*praːˑ¹*	'split open'		---	*kraːˑ³*	'mat'

Table 6: Examples by syllable type

For previously described Angkuic languages, U and Hu with tonal contrast have lost phonemic vowel length, while Mok that has not developed tone retains vowel-length contrast. Tone contrast in Angkuic is therefore believed to have developed at least in part from an earlier vowel length contrast, which has subsequently been lost (Svantesson 1988, 1991). As a tonal Angkuic language, Muak Sa-aak consequently would not be expected to retain its vowel length contrast. Angkuic languages do not display phonation contrast, either, yet with the exception of a tonal contrast in long smooth syllables, Muak Sa-aak could be interpreted as having two contrastive voice qualities. Therefore, since Muak Sa-aak does not seem to fit the pattern described for other tonal Angkuic languages, the following section will investigate possible tonogenetic processes.

3. Angkuic tonogenesis

As argued before, it is unlikely for an Angkuic language to undergo tonogenesis involving loss of an initial voicing contrast, because instead of tone, they developed contrastive aspiration from an older voicing contrast (Svantesson 1988). As an Angkuic language, Muak Sa-aak also has undergone this shift towards aspiration of initials (Hall 2010), so that tonal distinctions would be expected to have developed from loss of contrastive vowel length as seen in Hu, or from a combination of vowel length contrast and syllable type displayed by U, for which accompanying laryngeal features of tone have been recorded (Svantesson 1991, 1988). However, unlike U and Hu, Muak Sa-aak preserves a vowel length contrast. As described below, the development of three tones in Muak Sa-aak appears to be linked to two other factors: loss of certain final consonants, as reported for U (Svantesson 1988), and possibly borrowing from Tai Lue (cf. Thurgood 1996).

Svantesson (1988) compared his U data to Lamet to investigate the loss of vowel length contrast in U, since Lamet, unlike many other Palaungic languages, retains the vowel length distinction. Next to vowel length, final consonant type influences tonogenesis in U, with the key factor being sonorant versus non-sonorant final. In order to find any similar patterns, these data from Muak Sa-aak are being compared with Svantesson's Lamet data (1988).

Muak Sa-aak tonogenesis seems to be only partially affected by vowel length because unlike Hu or U, most sonorant-final words have retained their vowel length contrast and carry the same tone, falling Tone 3, regardless of vowel length. Table 7 indicates that vowel length in the Muak Sa-aak words with falling Tone 3 corresponds with Lamet vowel length. The respective Hu words display no length contrast but show two different tones instead; the high tone corresponds to the short vowels seen in Muak Sa-aak and Lamet; the low tone corresponds to the long vowels in Muak Sa-aak and Lamet. In U the situation is more complicated as there are more tones, and factors other than historical vowel length are also involved. Note that /ua/ in Muak Sa-aak is a long vowel, and that diacritics in Lamet indicate register.

	Muak Sa-aak	Lamet (Lametic)	Hu (Angkuic)	U (Angkuic)
'die'	*jam³*	*jàm*	*jám*	*jàp*
'star'	*s.mɤɲ³*	*krmɨ̀ɲ*	*mɛ́ɲ*	*samèt*
'heavy'	*k.cɛn³*	*kcèn*	*ncén*	
'cry'	*ja:m³*	*jà:m*	*jàm*	*jâm*
'white'	*s.pual³*	*pà:ɲ*	*pàɲ*	*pán*
'water'	*ʔo:m³*	*ʔó:m*	*ʔɔ̀m*	*ʔóm*

Table 7: Vowel length: Muak Sa-aak, Lamet, Hu
(Lamet, Hu and U from Svantesson 1988, 1991)

Although the majority of Muak Sa-aak sonorant-final words carry falling Tone 3, some do carry either low Tone 1 or the falling allotone of constricted Tone 2. Almost none of these words in the data set could be matched up with Lamet cognates, where vowel length is still contrastive, in Svantesson's list. When comparing Muak Sa-aak with Tai Lue, however, many Muak Sa-aak constricted Tone 2 words with sonorant finals appear to be Tai Lue cognates (Tai Lue from Hanna 2012). Examples are: Muak Sa-aak *ruan²* versus Tai Lue *hɔn*^{6} 'hot'; Muak Sa-aak *ra:j²* versus Tai Lue *ha:j*^{6} 'bad'; Muak Sa-aak *fuan²* versus Tai Lue *fɔn*^{6} 'dance'; Muak Sa-aak *ha:m²* versus Tai Lue *haam³* 'forbid'. Note that tones 3 and 6 in Tai Lue are glottalized tones, directly correlating with Muak Sa-aak constricted Tone 2 here.

Short open Muak Sa-aak syllables with the short allotone of Tone 2, frequently realized phonetically with a glottal stop, correlate with Lamet syllables with final glottal stops, whether the Lamet vowel is long or short. A similar phenomenon is seen in the Angkuic language Hu, where the tone contrast appears to be neutralized before the glottal stop finals; only high tone is found in this environment (Svantesson 1991). Therefore it appears that in this environment, the vowel length contrast in Muak Sa-aak has been lost. It is not reflected in a tone contrast, either, resulting in a neutralization of an earlier length contrast. Examples are shown in Table 8 below.

	Muak Sa-aak	Lamet (Lametic)	U (Angkuic)
'rope, string'	*p.cʰi²*	*plsíʔ*	*sí*
'dog'	*cʰɔ²*	*sɔ́ʔ*	*sò*
'wind'	*s.ma²*	*ʔmá:ʔ*	*samà*
'fish'	*kʰa²*	*ká:ʔ*	*khà*

Table 8: Reflexes of glottal stop finals and resulting tones in Muak Sa-aak
(Lamet and U taken from Svantesson 1988)

Cognates to Muak Sa-aak long open syllables with the falling allotone of constricted Tone 2 do not occur in Svantesson's Lamet vocabulary. As with the sonorant-final words carrying this tone, many appear to be borrowings from Tai Lue. It is hypothesized that the development of this allotone may be an outcome of language contact. Since these two finals do not occur in Tai Lue, words ending in those finals are unlikely to be loanwords. Syllables with nasal finals occur primarily with Tone 3. If they carry Tone 2, they tend to be Tai Lue borrowings. Examples: Muak Sa-aak ***na:²*** *ŋa:j³* versus Tai Lue *na:*^{3} 'face'; Muak Sa-aak *kʰa:²* versus Tai Lue *kʰa:*^{3} 'slave'; Muak Sa-aak *t.ŋa:²* versus Tai Lue *ŋa:*^{4} 'sesame seed'; Muak Sa-aak *ɲu:²* versus Tai Lue *ju:*^{6} 'push' (Tai Lue from Hanna 2012).

The distribution of the final stops /p, t, c, k/ differs from that of the glottal stop in Muak Sa-aak; the final stops may be found with tone 1 or the high allotone of Tone 2, but the glottal stop occurs phonetically only with Tone 2, either the high or the falling allotone. This suggests that the glottal stop should be interpreted not as a phonemic segment but as a tone-related laryngeal feature of Tone 2. For short vowels,

final stops motivate the high allotone of constricted Tone 2 but long vowels with stop finals result in low Tone 1 where the glottal stop cannot occur. Low Tone 1 words have no short vowels occurring with stop finals; nor are there any Tone 2 words occurring with long vowel and stop finals. Muak Sa-aak vowel length fully corresponds with the Lamet data in this environment, so the development of tone may have been motivated by the vowel length contrast without neutralizing it. See Table 9 for comparison of the Muak Sa-aak to the U and Lamet data.

	Muak Sa-aak	Lamet	U (Angkuic)
'rope, string'	*p.cʰi²*	*plsíʔ*	*sí*
'dog'	*cʰɔ²*	*sɔ́ʔ*	*sò*
'wind'	*s.ma²*	*ʔmá:ʔ*	*samà*
'fish'	*kʰa²*	*ká:ʔ*	*khà*
'bite'	*kak²*	*kàk*	*káʕ*[5]
'hair'	*suk²*	*khúk*	*súʕ*
'pig'	*le:k¹*	*lì:k*	*líʕ*
'bow, crossbow'	*ʔa:k¹*	*ʔá:k*	*ʔăʕ*

Table 9: Stop finals and resulting tones in Muak Sa-aak (Lamet and U from Svantesson 1988)

There are few Muak Sa-aak open syllables occurring with Tone 1; these words correlate to Lamet data with final /-h/ or /-s/. It is unclear at what point in time these finals were lost. Table 10 shows some of these words in comparison with Lamet and U from Svantesson (1988). U, like Muak Sa-aak, has lost the final /-h/ and /-s/.

	Muak Sa-aak	Lamet	U (Angkuic)
'wide'	*wa:¹*	*wàh*	*vâ*
'charcoal'	*cʰe:¹*	*krsás*	*é*
'bear'	*kʰre:¹*	*krí:s*	*χí*
'barking deer'	*pʰo:j³*	*pó:s*	*pʰó*
However:			
'begin'	*kaw²*	*kɔ́:h*	*kɔ̀*

Table 10: Tone 1 words in Muak Sa-aak which may come from proto *-h or *-s finals (Lamet and U from Svantesson 1988)

In the last item, the Muak Sa-aak word has Tone 2 but the other words with final Lamet -s or -h occur with a low tone. Drawing definite conclusions in this area would require more data[6], and the loss of final /-h/ and /-s/ possibly having an impact on tonal development is an area for further study.

4. Summary

As discussed in this paper, even though Muak Sa-aak preserved its vowel length distinction, it developed three tones with accompanying phonatory features. For example, minimal pairs may be found for Tone 2 versus Tone 3 that differ only in phonation. The tonal system may almost be analyzed as having only two tones or registers, except for the long smooth syllables occurring with all three tones that make the interpretation as a three-tone language necessary.

In summary, sonorant-final Muak Sa-aak syllables have retained their vowel length contrast, and most take Tone 3. Of those that take a different tone, many appear to be borrowed words. Most open syllables

[5] Svantesson describes /ʕ/ as a voiced pharyngeal approximant. It is the reflex of historical final **k* (1988).

[6] These are the only items for which data on both Muak Sa-aak and Lamet were available.

likewise take Tone 3; those that take Tone 2 include many apparent borrowed words from Tai Lue, and there is some evidence that Tone 1 open syllables may result in words that historically had final /-s, -h/. For stop-final syllables, historically long vowels result in Tone 1, and historically short vowels result in the high allotone of constricted Tone 2; this vowel length contrast remains but has been doubled in a tone contrast. For historical glottal stop final syllables, neutralization appears to have taken place, such that whether the vowel was historically short or long, it is now short; these syllables all take the short allotone of Tone 2. The occurrence of the three tones is closely correlated to syllable structure, particularly final consonant type and vowel length. Tone is partially but not fully predictable based upon syllable structure. The clear restrictions on the occurrence of tones depending upon syllable type suggest that syllable structure had an impact on tonogenesis. Borrowing may have had an effect on the development of some of the tones, in particular the low stiff tone and the falling allotone of constricted Tone 2.

While previous studies of Angkuic languages have emphasized that tonogenesis resulted primarily from a loss of phonemic vowel length, Muak Sa- aak tonogenesis seems to be the result of a combination of the effects of vowel length and syllable codas. Vowel length contrast appears to contribute to tonogenesis without being replaced. Final consonant types involved in tonogenesis are sonorants and obstruents.

The distribution of Muak Sa-aak tones suggests that overall syllable structure is the primary motivating factor for tonogenesis in Angkuic. One remaining question is how tone and vowel length will continue to develop.

Another area for further research is the place of Muak Sa-aak within the Angkuic subgroup of the Palaungic languages. The presence or absence of tone and the retention or loss of the proto vowel length contrast in the various Angkuic languages might be used for subgrouping, as shown in Figure 1. Muak Sa-aak, like some Angkuic languages, has developed tone, but unlike the other tonal Angkuic languages, it has retained a full vowel length contrast. It has also retained a more complete vowel length contrast than Mok, which has been documented as retaining length contrast but which has not developed tone.

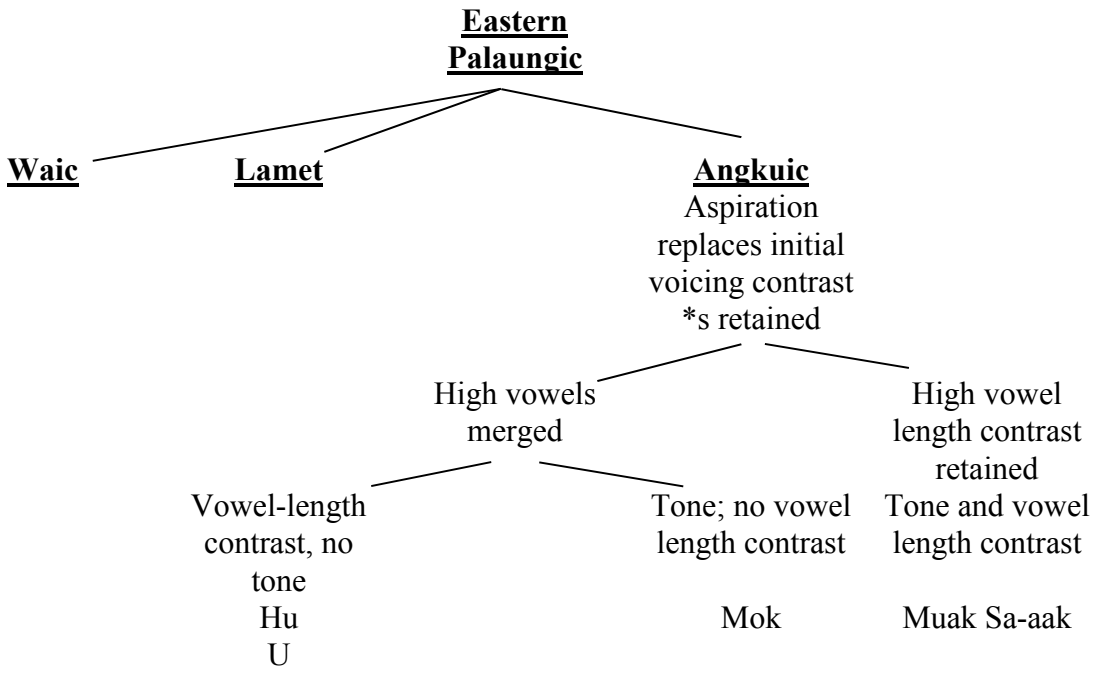

Figure 1: Angkuic languages by vowel length and tone

Suprasegmental features in Muak Sa-aak include pitch, voice quality, and vowel length. Within the Angkuic context of languages like U, Hu, and Mok, where tone and vowel length do not co-occur, this is evidence of the need for further studies of the relationships among languages of this branch. More data from other Angkuic languages is needed to provide a clearer picture.

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