Pitch, vowel duration, and phonation in Baima and neighboring languages

Katia Chirkova
CNRS-CRLAO

This paper focuses on tonal development in Baima, a little-studied Tibetic (Tibeto-Burman) language of China. Based on newly collected data and an updated phonological analysis, it addresses the phonetic and chronological challenges posited by the previous analysis of tonal developments in Baima by Huang & Zhang (1995). As suggested by historical-comparative evidence (correspondences between Baima and Written Tibetan), the three contrastive tonal categories in Baima have likely arisen through an overlay of the phonation difference in consonants (historically breathy vs. non-breathy) and the phonation difference in vowels (tense vs. lax, with pitch and vowel duration as co-articulated cues). I furthermore argue that the development of a tense/lax distinction is likely broadly shared by the Tibetic languages neighboring Baima. Recognition of such a multidimensional contrast (which may variously implicate differences in phonation, pitch, vowel duration, and vowel quality) provides a unified explanation for a number of seemingly unrelated and unusual characteristics of these Tibetic languages (such as rhyme length and onset aspiration as pathways leading to distinctive low register). The clustering of Tibetic languages with a tense/lax distinction in the historically multilingual area at the border of the present-day Northern Sichuan and Southern Gansu is further brought in connection with local non-Tibetic languages, some of which possibly share a structurally similar voice quality contrast that involves sets of correlated phonetic properties associated with phonatory, tonal, and vowel quality.

Keywords: tonogenesis, phonation contrasts, tense/lax vowel contrast, Baima, Tibetic languages

1. Introduction

This paper examines the historical development of tone in Baima in the context of its neighboring languages. Baima (ISO-639 *bqh*) is a little-studied Tibeto-Burman

https://doi.org/10.1075/lali.00188.chi | Published online: 7 March 2025
Language and Linguistics 26:2 (2025), pp. 224–261. ISSN 1606-822X | E-ISSN 2309-5067

language spoken at the border of Sichuan 四川 and Gansu 甘肅 provinces in the People's Republic of China. The language has approximately 10,000 speakers, who reside in the counties of Pingwu 平武, Songpan 松潘 /Zung chu, and Jiuzhaigou 九寨溝 /Gzi rtsa sde dgu in Sichuan Province, and in the counties of Wenxian 文縣 and Zhouqu 舟曲 /'Brug chu in Gansu Province (see Sun et al. 2007: 1; Suzuki 2015a: 120). Baima is spoken in an area of great ethnic and linguistic diversity, with various Tibeto-Burman and Sinitic (Mandarin) languages as its immediate neighbors. Local Tibeto-Burman languages include various varieties of the Tibetic and Qiang (or Rma) groups.[1] Figure 1 shows this complex linguistic setting as well as some of the neighboring (non-Sinitic) languages of Baima.

Figure 1. Distribution of Baima and some of the neighboring languages[2]

Baima is the first Tibetic language of the area that has been brought to the attention of the linguistic audience in the 1980s, essentially owing to a distinct cul-

1. The term "Tibetic" refers to a family of languages derived from Old Tibetan, which was originally spoken in the Yarlung valley at the time of the Tibetan empire (7th–9th centuries) (Tournadre 2013). The Qiang language is spoken in Songpan county and the neighboring Heishui 黑水 /Khro chu, Maoxian 茂縣, Beichuan 北川, Wenchuan 汶川 /Lung dgu, and Lixian 理縣 /Bkra shis counties (Evans & Sun 2015).

2. Language names are italicized in larger font. Transcriptions for language names follow conventions in their respective descriptions. Tibetan county names are in Wylie's (1959) transcription.

tural identity of the group and the disputed question of their ethnic and linguistic classification. Hongkai Sun, who pioneered linguistic fieldwork on Baima in the late 1970s (see Sun 1980; Nishida & Sun 1990), argued that Baima differed from better studied Tibetic languages of China with respect to its phonological, lexical, and grammatical features and, for those reasons, should be viewed as "an independent language belonging to the Tibetan branch" (Sun 2003: 62).[3] This conclusion was contested in the follow-up linguistic work by Awang Cuocheng & Jianmin Wang (1988), Jichuan Zhang (1994a; 1994b; 1997), and Bufan Huang & Minghui Zhang (1995). Using data from the same variety of Baima (as spoken in Pingwu county), these scholars focused on providing Tibetan etymologies for Baima basic vocabulary and demonstrating regularity of sound correspondences between Baima and Old Tibetan (hereafter OT).[4] Based on these findings, Baima was argued to be a Tibetic language and tentatively placed into the Kham group, with which it was claimed to share a number of phonological characteristics. These include drastic simplification of the syllable structure, elimination of OT syllables codas, and the presence of tone (Huang & Zhang 1995: 104; Zhang 1997: 134–135, 140). In response to these findings, Hongkai Sun maintained that Baima featured a set of characteristic developments that set it apart from Kham Tibetan, also making it difficult, if not altogether impossible, to integrate Baima into the popular tripartite classification of Tibetic languages of China (that is, Central, Amdo, Kham) (Sun 2003: 63, 74–75; Sun et al. 2007: 207–218). Tone was cited as one such characteristic development. Sun pointed out that while the number of tones in Baima was similar to Kham Tibetan, the correspondences between its tones, onsets, and rhymes with Written Tibetan (hereafter WT) were "not as clear as those between Kham Tibetan and [WT]" (Sun 2003: 75).[5] Interestingly, the idiosyncratic nature of tonal developments in Baima also received independent confirmation from the proponents of the view that Baima is a Tibetic lan-

3. The Tibetic languages of China are traditionally divided into three groups: Central (or Dbus-gtsang), Kham, and Amdo, which correspond to the three namesake historical provinces of Tibet (e.g., Hu 1991: 112, 173–177). The Tibetan or Bodish branch of the Sino-Tibetan language family is a higher-order grouping, which brings together Tibetic languages, Tamangic languages, Tshangla, Bumthang, Kurtöp and some other languages (see Tournadre 2013: 105; Thurgood 2017: 9–15).

4. Old Tibetan refers to the phonological system underlying traditional Tibetan orthography, which for the most part can be recovered through a comparison of the modern dialectal reflexes of the orthographic (Written Tibetan) forms.

5. One example provided in Sun's work is the autonym of the Baima group, viz., /pe^{53}/ (e.g. Nishida & Sun 1990: 47). Sun argues that if taken to correspond to WT *bod*, the high tone reflex of that word is in contrast to regular developments in Kham Tibetic varieties, where OT voiced onsets as a rule yielded low tone (e.g. Gesang Jumian & Gesang Yangjing 2002: 78–79).

guage. In their discussion of the historical phonology of Baima, Huang & Zhang (1995) put forward a set of changes that are markedly distinct from the tonogenetic course in better studied Tibetic languages. Most importantly, they argued that the primary High-Low register split in Baima was induced by OT rhyme type, followed by secondary splits conditioned by OT onsets (through obstruent devoicing and cluster simplification). This is opposite to the order of changes as commonly attested in tonal Tibetic languages (see Sun 2003c for an overview). In sum, no consensus on the historical position of Baima has been reached as an outcome of the scholarly debate on the linguistic affiliation of that language in the 1990s and the early 2000s; also leaving unresolved some key details of the development of its tonal system.

Continuous linguistic fieldwork in the area in the following two decades brought to light more local Tibetic languages, which, similar to Baima, did not conform to the traditional three-way Central/Amdo/Kham phylogeny. These include Zhongu (Sun 2003a), Chos.rje (Sun 2003b), gSerpa (Sun 2006), Khalong (Sun 2007), and Thebo (Renzeng Wangmu 2013; Lin 2014). Similar to Baima, these languages appeared to possess unmistakable hallmarks of Tibetan-ness, such as a common core vocabulary and grammar derived from OT, regular sound correspondences with orthographic forms, and common phonological and lexical innovations of the Tibetic language family (such as the form *bdun* for 'seven', e.g. Zhongu /di/, gSerpa /vdon/, Thebo /dẽ/). At the same time, also resembling Baima, these languages diverged sharply in their lexicon and grammar from better known Tibetic languages, and displayed a number of unusual characteristics, including uncommon tonal developments, such as rhyme length and onset aspiration as innovative pathways leading to distinctive low register (Sun 2003c: 40–43). Discussing the issue of classification of these newly described Tibetic languages, Jackson T.-S. Sun (2003a) pointed out that the problem with ascertaining their position within the Tibetic language family laid rather in the traditional tripartite classification scheme of Tibetic languages, which because of its primary reliance on typological features, did not do sufficient justice to the actual diversity of modern Tibetan (ibid., pp. 794–798). In the absence of a rigorous classification of Tibetic languages which would admit as evidence only shared innovations pointing to a period of common history between subsets of dialects, Sun (2003a: 796–797) proposed to place all Tibetic languages of the area, including Baima, directly under OT as its first-order offshoots. A revised classification of Tibetic languages by Nicolas Tournadre (2013), said to be "essentially based on a genetic approach, but […] also [to include] geographical parameters, migration and language contact factors" (ibid., p. 121), proposed to group Baima together with some of its neighboring Tibetic languages, such as mBrugchu (or Drugchu), Thebo (or Thewo), Cone (or Chone), into one section of the Tibetic

family, namely, the Eastern section (ibid., p. 122). However, Tournadre (2013) did not discuss shared innovations that underlie that grouping. Hence, the position of Baima and its neighboring Tibetic languages (hereafter northeastern Tibetan languages) within the Tibetic language family remains insufficiently demonstrated.

Against this background, the present study makes the following contributions. First, it re-examines the historical development of tone in the Pingwu variety of Baima, addressing the challenges posited by the previous diachronic analysis of Baima in Huang & Zhang (1995). These include (i) the unusual chronology of tonal developments, and (ii) the unclear phonetic basis of the primary High-Low register split argued to be induced by OT rhyme type. This line of investigation is based on an updated phonological analysis of Pingwu Baima in Chirkova et al. (2023), which recognizes phonation contrasts in Pingwu Baima consonants and vowels. The present study first reviews the historical-comparative evidence for the newly proposed phonation contrasts with the goal to elucidate their underlying phonetic mechanisms. On that basis, it proposes that tonal developments in Pingwu Baima are primarily triggered by a tense/lax vowel distinction, conditioned by OT rhyme type. This development is argued to be followed by secondary splits based on a consonantal distinction, namely breathy vs. non-breathy, conditioned by OT onsets. Those proposed developments are corroborated by a high degree of regularity of correspondence between Pingwu Baima and OT, confirming that Baima is unmistakably a Tibetic language.

Second, the present study argues that the development of a tense/lax distinction is likely shared by Baima with its neighboring Tibetic languages, most importantly, Chos.rje, Cone, Thebo, and likely also mBrugchu, Zhongu, and Kun sngon. This development provides a unified explanation for seemingly unrelated and unusual characteristics of the Tibetic languages neighboring Baima, including their uncommon tonal developments. The development of a tense/lax distinction is further proposed as a possible diagnostic change pointing to a period of common history between these northeastern Tibetic languages, lending support to considering them as constituting a valid subset of languages within the Tibetic language family, as suggested in Tournadre (2013).

The remainder of the article is organized as follows. § 2 revisits the historical development of tone in Pingwu Baima. § 3 argues for the development of a tense/lax distinction in the Tibetic languages neighboring Baima. § 4 places tonal developments in Baima and its neighboring languages in an areal context and concludes the paper.

2. Tonal developments in Baima

This section first summarizes main similarities and differences between the existing phonological analyses of Pingwu Baima to justify the choice of Chirkova et al. (2023) as the basis for the present study (§ 2.1). It then discusses the historical origins of the phonation contrasts in Baima consonants and vowels (§ 2.2). This section is concluded by a revised analysis of tonal developments in Baima (§ 2.3).

2.1 Phonological analyses of Pingwu Baima: A comparison

Baima has been repeatedly surveyed since the early 1980s, with all existing descriptions being concentrated on one and the same variety of Baima: as spoken in Baima Township of Pingwu county (hereafter Baima). All descriptions (Awang Cuocheng & Wang 1988; Nishida & Sun 1990; Huang & Zhang 1995; Sun et al. 2007; Chirkova et al. 2023) agree in describing Baima as having: (i) a rich system of consonants (comprising (a) non-nasalized and prenasalized obstruents,[6] and (b) sonorants); (ii) a rich system of vowels (with only oral vowels in the native lexicon); and (iii) a simple syllable structure: (C)V(V), where C (which is optional) can be any phonemic consonant, and V stands for vowel. All descriptions also agree in describing Baima as a tonal language, where some tones display complex co-occurrence patterns with the onset of the tone-bearing syllable. At the same time, the existing phonetic and phonological sketches diverge quite considerably in their analysis of the consonant inventory of Baima and the related co-occurrence patterns of consonantal onsets and tone.[7] However, their analytic differences notwithstanding, all existing descriptions agree in differentiating between the same (near) minimal sets, thereby revealing a near-identical system of contrasts. This is exemplified in relation to the analyses by (i) Hongkai Sun (as presented in Nishida & Sun 1990 and Sun et al. 2007),[8] (ii) Huang & Zhang

6. Sequences of a nasal and a voiced stop or a voiced affricate (e.g. /mb, nd, ndz/) are here analysed as unitary segments (prenasalized stops and prenasalized affricates).

7. By contrast, different analyses of the vowel inventory are by and large comparable. To give an example, the number of monophthongs in the native Baima vocabulary is 13 in both Sun et al. (2007) (/i e ɛ a ɑ ɔ o u y ɿ ø ə ɐ/) and Huang & Zhang (1995) (/i e æ a ɑ ɔ o u y ø ʊ ə ɐ/), and it is 11 in Chirkova et al. (2023) (/i e ɛ ạ ɑ o ʊ u ʉ ʊ ə/). The apparent differences between the overall number of vowel phonemes in the three sources — that is, 45 in Sun et al. (2007); 48 in Huang & Zhang (1995); and 15 in Chirkova et al. (2023) — reflect the fact that the former two analyses include in their vowel inventories nasal vowels and diphthongs that are restricted in Baima to recent loanwords from Mandarin and for that reason, not included in the latter analysis.

8. Sun et al. (2007: 21–31) is an updated version of the analysis in Nishida & Sun (1990: 110–168), used hereafter as a collective reference to both studies.

(1995), and (iii) Chirkova et al. (2023), chosen for the reason that they provide most detail and are supported by most data of all published work on Baima.

Sun et al. (2007) posit 47 consonant phonemes (/p pʰ b m mb f ts tsʰ dz ndz s sʰ z t tʰ d nd n l r tʂ tʂʰ dʐ ndʐ tʃ tʃʰ dʒ ndʒ ʃ ʃʰ ʒ tɕ tɕʰ dʑ ndʑ ɲ ɕ ɕʰ ʑ k kʰ g ŋ ŋg x ɣ ɦ/). They analyze Baima as a tonal language typified by pitch with 4 tones on monosyllabic roots. These four tones include two falling tones (53, 341) and two rising tones (13, 35). This four-way tonal contrast is illustrated by two complete minimal sets, both in syllables with prenasalized onsets (Sun et al. 2007: 30), e.g. /mbo^{53}/ 'insect', /mbo^{35}/ 'wooden partition', /mbo^{13}/ 'to fall', /mbo^{341}/ 'to fly'. Overall, words with tones 53 and 35 appear most frequently in the accompanying data set (a word list of 3,000 words), whereas those with tone 13 are the least frequent.[9] A further complication is that tone 13 is said to be occasionally realized as [35] (ibid.), while minimal pairs for the contrast between tones 13 and 35 in Sun et al.'s (2007) data are few and far between. One example is /nɔ^{13}/ 'to exist' vs. /nɔ^{35}/ 'heaven, sky'. The difference between the two lower tones (13 and 35) is hence demonstrated less conclusively than that between other tones.

Huang & Zhang's (1995) analysis of Baima consonant phonemes includes phonation contrast in one onset type: sonorants. Specifically, the six plain sonorants (/m n ɲ ŋ l j/) all have breathy counterparts (respectively, /mɦ nɦ ɲɦ ŋɦ lɦ jɦ/). The resulting consonant inventory (that also additionally includes /w ʔ/) totals 55 phonemes. Huang & Zhang also analyze Baima as having four tones on monosyllabic roots. However, the precise tonal contours and the distribution of the four tones are different from those in Sun et al. (2007) (see Table 2). In addition, the four tones in Huang & Zhang's analysis are correlated with differences in vowel duration: the two higher tones (53, 42) are short, whereas the two lower tones (35, 341) are long. Minimal contrastive sets for tone in Huang & Zhang's (1995: 83–84) data are said to be mostly binary. Examples include /tɑ^{53}/ 'tiger' vs. /tɑ^{341}/ 'banner'; /ndzuɐ^{53}/ 'dzo (crossbreed of a yak and a cow)' vs. /ndzuɐ^{42}/ 'lake'; /de^{42}/ 'to sit; to live (IMP)' vs. /de^{35}/ 'seven'. Tones 53 and 35 are most frequent in the accompanying data set (a word list of slightly over 2,300 words) and may co-occur with most consonantal onsets. Conversely, tones 42 and 341 are less frequent and have restricted distribution. Tone 42 only occurs on syllables with voiced obstruent onsets (both non-nasalized and prenasalized), whereas tone 341 mainly occurs on syllables with breathy sonorant onsets.[10] A further complication

9. A manual count of monosyllabic words with tone 13 in Sun et al. (2007) yields slightly less than 30 words against over 170 words with tone 35. Tone 13 mostly occurs on syllables with voiceless aspirated and voiced obstruent onsets. Examples include /pʰɛ^{13}/ 'belly; stomach', /sʰe^{13}/ 'heart', /de^{13}/ 'seven'.

is that words with obstruent onsets and tone 341 are infrequent in the data set, while some words with that tone are occasionally variably transcribed with tone 35 (e.g. 'banner': /tɑ^{341}/ or /tɑ^{35}/; 'to drink (PST)': /ndʊ^{341}/ or /ndʊ^{35}/).[11] In sum, the difference between tones 35 and 341 is again demonstrated less conclusively than that between other tones.

Chirkova et al. (2023) recognize epiglottalization as secondary articulation in Baima consonants, thereby positing the largest number of consonant phonemes among all existing descriptions (namely, 57). They also recognize voice quality of the vowel as one of the phonetic correlates of tone. Detailed instrumental justification of that analysis can be found in Chirkova et al. (2023). That publication is accompanied by a sound archive in open access, which includes most minimal pairs cited in the present study.[12]

Table 1 details the division of all 57 consonant phonemes into epiglottalized and non-epiglottalized in Chirkova et al. (2023). Epiglottalized consonants have a harsh voice quality. Note that in non-nasalized voiced obstruents, epiglottalization is contingent on voicing. In contrastive epiglottalized vs. non-epiglottalized prenasalized obstruent and sonorant pairs, epiglottalized consonants are notated with the IPA superscript voiced epiglottal fricative or trill [ʕ].

Chirkova et al. (2023) analyze Baima as a tone language with a complex interrelation between (a) pitch height, (b) voice quality of the vowel, and (c) vowel duration. They posit three contrastive tonal categories: high falling, mid, and low, which show complex interactions with syllable onset types (see Table 2). The high falling tonal category is correlated with a high falling pitch contour, tense vowel quality, and short vowel duration. It co-occurs with all possible onset types, including also epiglottalized onsets (e.g. /^{m}bû/ 'insect', /^{m}bʕû/ 'to fly').[13] The mid

---

10. All examples of words with breathy sonorant onsets in Huang & Zhang (1995) have tone 341, with the only exception of /ɲ^{ɦ}yæ^{35}/ 'bamboo'. Note that words with breathy sonorant onsets in Huang & Zhang's data, which are described as long and carrying one tone (341), correspond to words with two different tones in Sun et al. (2007) data (341 and 35) and to words differentiated in both duration and tonal category in Chirkova et al. (2023) data (short, high falling vs. long, low) (see 'pus', 'to exist' in Tables 3–4). In the absence of (i) a more detailed discussion in Huang & Zhang (1995) and (ii) sound files accompanying that analysis, reasons for these discrepancies remain unknown.

11. A manual count of all monosyllabic words with obstruent onsets and tone 341 yields 20 tokens against over 80 words with tone 35.

12. Sound files can be found at: ⟨https://www.cambridge.org/core/journals/journal-of-the-international-phonetic-association/article/abs/baima/E50FDF5B09AE046CB2BC4B18172C8159#supplementary-materials⟩.

13. Note that the voice quality of syllables beginning with epiglottalized consonants results from the interaction of the default voice quality of the high falling tonal category (that is, tense)

Table 1. Epiglottalized and non-epiglottalized consonants

Consonant phonemes	Epiglottalized	Non-epiglottalized
non-nasalized obstruents (stops, affricates, fricatives)	b d g	p p^h t t^h k k^h
	dz dʒ dʐ ɖʈ	ts ts^h tʃ $tʃ^h$ tɕ $tɕ^h$ ʈʂ $ʈʂ^h$
	z ʒ ʐ ɣ	s s^h ʃ $ʃ^h$ ɕ $ɕ^h$ x
prenasalized obstruents	$^m b^ʕ$ $^ŋ g^ʕ$ $^n dz^ʕ$ $^n dʒ^ʕ$ $^ɲ dʐ^ʕ$	$^m b$ $^n d$ $^ŋ g$ $^n dz$ $^ɲ dʐ$ $^n ɖʈ$
sonorants (nasals, approximants)	$m^ʕ$ $n^ʕ$ $ɲ^ʕ$ $ŋ^ʕ$ $j^ʕ$ $l^ʕ$	m n ɲ ŋ r j l w

and low tonal categories are correlated with long vowel duration. The mid tonal category has a mid level pitch contour and a modal voice quality (e.g. /^{n}ndzū/ [^{n}dzu^{33}] 'female dzo'). It co-occurs with the least number of onset types (viz., voiceless unaspirated and prenasalized obstruents, sonorants). The low tonal category has a low falling-rising pitch contour and a breathy-like or lax voice quality (e.g. /^{n}dzù/ [^{n}dzṵ^{213}] 'to sell (IPFV)'). It co-occurs with all onset types but voiceless unaspirated obstruent. As a result of these complex interactions between syllable onsets and tones, only syllables with sonorant and prenasalized obstruent onsets allow the full set of tonal contrasts. Examples include /nô/ 'inside', /nō/ 'heaven, sky', /nò/ 'to exist'; /^{ŋ}guê/ 'to bark', /^{ŋ}guē/ 'pan', /^{ŋ}guè/ 'downstairs'. Syllables with the remaining onset types exhibit two-way tonal contrasts: (i) high falling vs. mid in syllables with voiceless unaspirated obstruent onsets, as in /tâ/ 'tiger' vs. /tā/ 'banner'; and (ii) high falling vs. low in syllables with voiceless aspirated and voiced obstruent onsets, as in /t^hâ/ 'hempen cloth' vs. /t^hà/ 'thick rope'; /dê/ 'to sit; live (PFV)' vs. /dè/ 'seven'.

Table 2 compares tone values, onset types, and tone-onset co-occurrence patterns in Sun et al. (2007), Huang & Zhang (1995), and Chirkova et al. (2023). As can be seen from Table 2, the three analyses largely agree on a relative pitch height difference among the falling or short tones that shows a strong correlation with the onset of the tone-bearing syllable. That contrast is confirmed by the same (near) minimal sets, as shown in Table 3. In all three analyses, pitch height in syllables with non-nasalized obstruents is correlated with onset voicing: higher in syllables with voiceless onsets and lower in syllables with voiced onsets. On the other hand, the nature of a similar contrast in syllables with prenasalized obstruent onsets in Sun et al. (2007) and Huang & Zhang's (1995) analyses is unspecified, whereas in syllables with sonorant onsets in Huang & Zhang's analysis, it appears correlated with the phonation type of the onset (a higher tone in sylla-

and the harsh voice quality due to consonantal epiglottalization. The consonant-derived harshness typically does, but need not, replace the tone's default voice quality.

bles with non-breathy onsets, and a lower tone in syllables with breathy onsets). In Chirkova et al.'s (2023) analysis, relative pitch height in short syllables is uniformly correlated with the phonation type of the syllable onset: higher on syllables with non-epiglottalized onsets, and lower on syllables with epiglottalized onsets. Given that relative pitch height is predictable on the phonation type of the syllable onset, it is not considered contrastive.

Table 2. Tone values, onset types, and tone-onset co-occurrence patterns[14]

H. Sun et al. (2007)		Huang & Zhang (1995)			Chirkova et al. (2023)			
Pitch	**Onset type**	**Pitch**	**Length**	**Onset type**	**Pitch**	**Length**	**Phonation**	**Onset type**
53	T T^h ND S	53	short	T T^h ND S	high	short	tense	T T^h ND S
341	D ND S	42		D ND	falling			D $^ND{}^ʕ$ $S^ʕ$
35		35		S	mid		modal	T ND S
13	T T^h D ND S	341	long	T T^h D ND Sɦ	low	long	breathy-like or lax	T^h D ND S

Table 3. Examples of (near) minimal sets for the relative pitch height contrast in the falling or short tones

Gloss	Sun et al. (2007)	Huang & Zhang (1995)	Chirkova et al. (2023)
grass	tsa^{53}	tsa^{53}	ts$\underline{\hat{a}}$
salt	ts^{h}a^{53}	ts^{h}a^{53}	ts$^h\underline{\hat{a}}$
tongue	dʒɑ^{341}	dʒɑ^{42}	dʒ$\hat{a}$
insect	mbo^{53}	mbu^{53}	^{m}b$\hat{u}$
to fly	mbo^{341}	mbu^{42}	^{m}b$^ʕ\hat{u}$
dzo (crossbreed of a bull and a yak cow)	ndzɐ^{53}	ndzuɐ^{53}	^{n}dz$\hat{e}$
lake	ndzɐ^{341}	ndzuɐ^{42}	^{n}dz$^ʕ\hat{e}$
forest	(ʃ^{h}e^{13})nɑ^{53}	nɑ^{53}	n$\hat{a}$
pus	nɑ^{341}	nɦɑ^{341}	n$^ʕ\hat{a}$

In contrast, the three analyses essentially disagree on the distribution of and the relationship between the two rising or long tones. In Sun et al. (2007) and Huang & Zhang's (1995) analyses, both rising or long tones can be formally associated with most, if not all consonantal onsets. However, the few supporting

14. The dotted lines reflect the fact that the differences between those tones are described less exhaustively and supported by fewer examples than those between other tones.

minimal pairs that can be found in the accompanying data sets are principally restricted to syllables with prenasalized obstruent and sonorant onsets, as shown in Table 4.

Table 4. Examples of minimal pairs for the rising or long tones

Gloss	Sun et al. (2007)	Huang & Zhang (1995)	Chirkova et al. (2023)
wooden partition	mbo^{35}	mbʊ^{341}	^{m}bù
to fall	mbo^{13}	mbɔ^{341}	^{m}bò
heaven, sky	nɔ^{35}	nɔ^{35}	nō
to exist	nɔ^{13}	nɦɔ^{341}	nò
female dzo		ndzʊ^{35}	^{n}dzū
to sell (IPFV)		ndzu^{35}	^{n}dzù

Furthermore, minimal pairs for the contrast between the rising or long tones in one analysis (as in Sun et al. 2007 or Chirkova et al. 2023) may variously correspond to those for the contrast in vowel quality and/or likely syllable-level phonatory quality (as in contrastive pairs with breathy and non-breathy sonorant onsets in Huang & Zhang's (1995) data) (see examples in Table 4). Chirkova et al. account for these variable manifestations of the underlying contrast, as supported by the same minimal pairs in all three data sets, by describing it as one that combines differences in pitch and vowel voice quality. From that perspective, differences in the description of that contrast in previous analyses can be explained as reflecting the fact that voice articulation, acoustics, and perception are inherently multidimensional and realized with multiple covarying cues, which include vowel quality differences (see Kuang 2011a, 2011b; Garellek 2019, 2022).

In sum, recognition of phonation differences, as in Chirkova et al. (2023), has the advantage of providing a more accurate and systematic account of the system of contrasts in Baima, as independently confirmed by the three analyses compared in this section. The phonological analysis of Baima in Chirkova et al. (2023) will hereafter be used as the basis for a revised diachronic analysis of tonal developments in that language.

2.2 Tonal developments in Baima revisited

The diachronic analysis of Baima in Huang & Zhang (1995: 99–102), based on their synchronic phonological analysis, describes the development of tone in Baima as proceeding in two stages. The first stage is said to be conditioned by OT rhyme type. It yields contrastive vowel duration and pitch. Specifically, Huang &

Zhang suggest that OT open syllables and syllables with OT stopped codas (*-b*, *-d*, *-g*; as well as those with the coda *-r*)[15] evolved into short syllables with a high falling tone (高降調). In contrast, OT coalesced syllables (that is, syllables resulting from fusion of an OT open-syllable vowel with one of the suffixes *-ba*, *-bo*, *-ma*, *-mo*, *-'u*) and syllables with OT continuant codas (*-m*, *-n*, *-ng*, *-s*, *-l*) evolved into long syllables with a low rising tone (低升調). The second stage is analyzed as conditioned by OT onsets and includes secondary splits within the primary short high-falling and long low-rising tones. Table 5 summarizes the two stages of tonal developments in Huang & Zhang's (1995: 101–102) analysis.

Table 5. Tonal developments in Baima

Stage 1		**Stage 2**			
OT rhyme	**Tone** / **length**	**Baima onset non-breathy**	**Tone**	**Baima onset breathy**	**Tone**
-b, *-d*, *-g* open	high falling	voiceless obstruent (< OT voiceless initial)	53		
		prenasalized obstruent (< OT voiced initial with nasal preinitial)			
		sonorant (< OT simplex sonorant)			
	short	voiced obstruent (< OT voiced initial)	42	sonorant	
		prenasalized obstruent (< OT voiceless aspirated initial with nasal preinitial)		(< some OT sonorants	341
-m, *-n*, *-ng*, *-s*, *-l* coalesced syllables	low rising long	all types (coalesced syllables < OT voiced initial > 35 coalesced syllables < OT voiceless initial > 341)	35 / 341	with preinitials)	

This analysis posits phonetic and chronological challenges. (i) The phonetic basis for the primary tone split is not addressed in Huang & Zhang's (1995) work and is not clear. (ii) While the proposed phonetic basis for secondary splits (onset voicing) is reasonably well understood, the contradictory nature of Baima devel-

15. As noted by Huang & Zhang (1995: 99), OT rhymes with the coda *-r* have the same reflexes as syllables with zero coda, for which reason it is likely that *-r* was lost early in the history of Baima.

opments rather suggests that these secondary tonal splits may have some other basis.[16] (iii) The proposed chronology of changes — that is, a primary High-Low register split induced by OT rhyme type followed by secondary splits conditioned by OT onsets — is uncommon among Tibetic languages, which normally evidence the reverse order of change (viz., a primary register split conditioned by OT onsets, which may be followed by the development of distinctive pitch contours conditioned by OT codas). Possibly in view of these problems, in the seminal contribution on tonal developments in Tibetic languages by Jackson T.-S. Sun (2003c), Baima is cited as an example of low register induced by onset voicing (that is, stage 2 in Table 5), while disregarding the role of OT rhymes in tonal developments (that is, stage 1 in Table 5).

The present study addresses these challenges on the basis of the new phonological analysis of Baima in Chirkova et al. (2023). This section first revisits the historical development of the contrast between short and long vowels, which in Chirkova et al.'s (2023) analysis, also includes an associated difference in vowel voice quality (respectively, tense vs. non-tense or lax) (§ 2.2.1). It then discusses the historical development of a phonation contrast in Baima consonants (§ 2.2.2). This section concludes with a revised analysis of tonal developments through an overlay of a tense/lax vowel distinction and the phonation contrast in consonants, addressing the chronological order of changes (§ 2.2.3).

2.2.1 Phonation contrast in Baima vowels

Table 6 provides examples of the two sets of vowels as conditioned by OT rhyme type, which in Huang & Zhang's (1995) analysis are characterized by contrastive vowel duration and pitch. The new proposal in Chirkova et al. (2023) is that short and higher-pitched vowels have a tense voice quality, whereas long and lower-pitched vowels have a contrastive non-tense (modal and breathy-like or lax) voice quality.

---

16. The distribution of the two short tones in syllables with prenasalized obstruent onsets (which represent a merger of OT voiced and voiceless stops and affricates with the nasal preinitials *m-* and *'-*) unexpectedly displays the reverse of the universal pattern of voicing-based tone bifurcation. Specifically, syllables with OT *voiced* stops and affricates acquired a *higher* tone (53) (as in /mbu^{53}/ 'insect', WT *'bu*), whereas syllables with OT *voiceless* aspirated stops and affricates acquired a *lower* tone (42) (as in /mbu^{42}/ 'to fly', WT *'phur*) (Sun 2003c: 39–40). The distribution of the two long tones in coalesced syllables evidences yet another split at variance with the purported voicing-based tonogenetic path. Coalesced syllables from OT disyllabic words with *voiced* onsets acquired a *higher* long tone (35, phonetically [35~354~55], as in /so^{35}/ 'food', WT *za ma*), whereas coalesced syllables from OT disyllabic words with *voiceless* onsets acquired a *lower* long tone (341) (as in /s^{h}æ^{341}/ 'charcoal', WT *sol ba*) (Sun 2003c: 40).

Table 6. Development of OT rhymes in Baima

	Vowel duration			
OT rhyme	**F0**	**Example**		
	Phonation	**Gloss**	**WT**	**Baima**
codas *-b*, *-d*, *-g*		needle	*khab*	kʰâ̰
		voice; language	*skad*	kê
	short	to be hungry	*ltogs*	tuê
coda *-r*	higher-pitched	to fly	*'phur*	ᵐbʢû
	tense	mouth	*kha*	kʰâ̱
open		four	*bzhi*	ʒə̂
		year	*lo*	jə̂
		insect	*'bu*	ᵐbû
codas *-m*, *-n*, *-ng*		to be dry	*skam*	kō
		bottom part	*gdan*	dɛ̀
		lap; bosom	*pang*	pō
codas *-l*, *-s*	long	to sleep	*nyal*	ɲɛ̄
	lower-pitched	rice	*'bras*	ⁿdɻɛ̄
coalesced	non-tense	food	*za ma*	sō
syllables		snow	*kha ba*	kʰà

The phonetic basis for the development of the phonation-type contrast between tense and non-tense vowels and related associations with vowel duration and pitch are more readily understandable in syllables with OT codas. Specifically, the development of a relatively more laryngealized (creaky-like or tense) phonation in syllables with stopped codas (that is, V-*b* [p]/-*d* [t]/-*g* [k] → Vʔ → V̰) has parallels in many Tibeto-Burman languages with contrastive vowel voice quality.[17] It has been most extensively explored in relation to various Lolo-Burmese languages (such as Hani, Akha, Yi, Burmese), where tense phonation has been argued to arise from the transference of the laryngealized/glottalized feature of voiceless stop codas to the preceding vowel (e.g. Bradley 1979: 193–205; Maddieson & Ladefoged 1985 for Hani and Yi; Gruber 2011 for Burmese). In contrast to a relatively more laryngealized (creaky-like or tense) phonation in syllables with

17. Related developments include merger of stopped codas into a single glottal stop, which may be further replaced by vowel glottalization (used here as a general term for non-modal phonation with stiffened vocal fold phonation, see Ladefoged 1973), which may in turn be further produced with a creaky phonation (e.g. Blankenship 2002; DiCanio 2012 and references therein).

historically checked syllables, syllables with continuant codas (as well as vowel-final rhymes) in Lolo-Burmese languages developed a relatively laxer voice quality. It is conceivable that the development of tenser vowels in Baima syllables with OT stopped codas and that of contrastively non-tense vowels in syllables with OT continuant codas has proceeded along similar lines. (Further developments in Baima non-tense, long vowels, resulting in contrasting modal and breathy-like or lax vowels, are detailed in § 2.2.3.)

Cross-linguistically, the essential property of a tense/lax distinction is contrastive phonation. However, given that related tension settings are each manifested by a constellation of more local settings at various points in the vocal system (Laver 1980: 154–155; Edmondson & Esling 2006; Kuang 2011a, 2011b), a tense/lax contrast is usually accompanied by acoustic correlates from multiple dimensions, which include f0, vowel quality, and vowel duration. For example, in some Lolo-Burmese languages, such as Hani (Maddieson & Ladefoged 1985: 448–449), Bo (Kuang 2011b), and Burmese (see Bradley 1982; Gruber 2011), essential manifestations of the tense/lax contrast include differences in (i) phonation type, (ii) f0 (through the tensing of the vocal cords resulting in a raised position of the larynx), and (iii) vowel duration (the shorter duration of tense vowels relates to a tighter muscle constriction in the vocal cords, whereas the longer duration of lax vowels can be related to slacker vocal cord constriction). In some other Lolo-Burmese languages, such as Northern Yi (Nuosu), the phonation contrast also involves supraglottal articulations. Laryngoscopic studies of Nuosu (Edmondson et al. 2001; Esling & Edmondson 2002; Edmondson et al. 2017; see also Esling et al. 2019: 149–150) demonstrate that the tense/lax distinction in that language does not affect phonation type as much as it changes the resonance characteristics of the lower pharyngeal vocal tract. Specifically, the production of the tense phonation involves retracting the tongue root and raising the larynx, so that tense vowels tend to be significantly lower (higher F1 and lower F2) and have more back vowel quality than their lax counterparts. In Baima, essential manifestations of the tense/lax contrast include contrastive phonation, f0, and vowel duration. The contribution of vowel quality, on the other hand, does not appear significant, as most vowels (e.g. /e, ɛ, ʉ, ɑ/) can be both tense (short) and non-tense (long).

The development of a laxer voice quality in longer syllables with OT continuant codas suggests a possible explanation for the unusual lack of nasal vowels in Baima, which in Tibetic languages commonly develop from OT syllables with nasal codas (*-m*, *-n*, *-ng*) (cf. Qu 1991: 17). It is conceivable that the loss of OT nasal codas in Baima originally resulted in vowel nasalization (that is, V-*m*/-*n*/-*ŋ* → Vŋ ~ Ṽː), as is the case in Central and Kham Tibetic varieties (e.g. Qu 1991: 24–25). A subsequent loss of vowel nasalization in Baima may be related to the following two general characteristics of lax voice: (i) breathiness as a fre-

quent component of lax voice (Laver 1980: 146), and (ii) moderate nasality that frequently accompanies lax voice (because of the relative relaxation of the musculature of the vocal tract, including the local velopharyngeal system, ibid., p. 149). Given that breathiness and nasality are acoustically similar — breathy vowels (caused by vocal fold spreading during voicing) and nasalized vowels (caused by velum lowering) both have higher spectral tilt (e.g., Klatt & Klatt 1990; Ohala & Ohala 1993; Garellek et al. 2016) — they have a mutually enhancing effect. This mutually enhancing effect can further lead to listener misperception. The listener can misperceive syllables that are both breathy and nasal as only breathy, and then the listener-turned-speaker produces those syllables as only breathy-like (or lax) (that is, $\tilde{\underline{V}}\text{ː} \rightarrow \underline{V}\text{ː}$).

The phonetic basis for a parallel development of contrastively tenser and laxer phonation in OT open and contracted disyllabic forms, which in Baima join, respectively, the tenser and laxer vowels in syllables with OT codas, is less straightforward and does not appear to have clear parallels in the neighboring languages.[18] One possible explanation for such a development is that it could be initiated by the development of laxer phonation in coalesced syllables.[19] Related developments would proceed as follows. Contraction of OT open-syllable vowels with the suffixes *-ba*, *-bo* would first involve reduction of the intervocalic labial stop to [ɦ] (that is, CV CV → CVɦV). Further contraction may result into a long breathy syllable (that is, CVɦV → $\text{CV}\text{ːʱ} \rightarrow \text{C}\underline{\text{V}}\text{ː}$). Conversely, contraction of OT open-syllable vowels with nasal-initial suffixes (OT *-ma*, *-mo*, *-'u*) would proceed through a stage of vowel nasalization (CV NV → CVŋ ~ $\text{C}\tilde{\text{V}}\text{ː}$). It is conceivable that in long syllables with nasalized vowels, vowel nasalization could be reinterpreted as breathiness due to the acoustic similarity of breathiness and nasality ($\text{C}\tilde{\underline{\text{V}}}\text{ː} \rightarrow \text{C}\underline{\text{V}}\text{ː}$, see above). Finally, the development of laxer phonation in long coalesced syllables likely further led to the tensing of vowels that evolved from OT open syllables.

As a result of these developments in rhymes with OT codas, coalesced syllables and syllables with OT open rhymes, Baima likely acquired two sets of vowels, of which one is relatively more tense and correlated with a shorter duration and a higher pitch, and the other is relatively laxer and more correlated with a longer duration and a lower pitch. Related phonetic processes, as described in this section, provide a phonetically-motivated explanation for the first stage of tonal developments in Baima conditioned by OT rhyme type, as proposed in Huang & Zhang (1995) (see Table 5).

---

18. For example, in Lolo-Burmese languages, vowel-final syllables rather join nasal- and approximant-final syllables to contrast with stop final syllables (e.g. Bradley 1979: 206).

19. I am grateful to Ryan Gehrmann for this suggestion.

2.2.2 Phonation contrast in Baima consonants

The contrast between epiglottalized and non-epiglottalized consonants, as described for Baima in Chirkova et al. (2023), is restricted to short syllables. Yet, in long syllables, it by and large corresponds to the contrast between the mid and low tonal categories, associated with differences in vowel phonation type (respectively, modal vs. breathy-like or lax), pitch (respectively, mid level and low falling-rising), and also distinct subsets of consonantal onsets. This is detailed in Table 7, which reorganizes Baima syllable onsets by vowel duration.

Table 7. Onset, rhyme, and tone contrasts in short and long syllables

Short Tense							Long Non-Tense					
Onset					**Rhyme**	**Tone**	**Onset**				**Rhyme**	**Tone**
epiglottalized	D		$^{n}D^{ʕ}$	$S^{ʕ}$	tense	high	D	**T^{h}**	^{n}D	S	breathy-like or lax	low falling-rising
non-epiglottalized	T	**T^{h}**	^{n}D	S		falling	T		^{n}D	S	modal	mid level

Note that voiceless aspirated obstruents (T^{h}, highlighted in bold in Table 7) are exceptional in that in short syllables, they pattern together with non-epiglottalized onsets (such as voiceless unaspirated obstruents, T), whereas in long syllables, they pattern together with the onsets that occur in the low tonal category (such as voiced obstruents, D). This exceptional syllable onset type aside, the binary phonation contrasts in both short and long syllables appear to be correlated each with a distinct subset of consonants. One subset occurs with non-modal phonation types, that is, epiglottalized onsets in short tense syllables and syllable onsets in long breathy-like or lax syllables, that is, D̰V/D̰V̰ː, $^{n}D^{ʕ}$̰V/^{n}D̰V̰ː, $S^{ʕ}$̰V/S̰V̰ː (hereafter historically non-modal consonants). The other subset is correlated with modal phonation types, that is, non-epiglottalized onsets in short syllables, and syllable onsets in long modal syllables, that is, T̰V/TVː, ^{n}D̰V/^{n}DVː, S̰V/SVː (hereafter historically modal consonants). This division on distributional grounds is further supported by differences in the respective historical origins of these two subsets of consonants.

OT origins of Baima historically non-modal consonants include: (i) OT clusters with non-nasal preinitials and voiced obstruent and sonorant initials, and (ii) OT clusters with nasal preinitials and voiceless aspirated stop and affricate initials. Table 8 provides some examples.

Table 8. OT origins of historically non-modal consonants in Baima

Vowel Consonant	V̲			V̲ː		
	Gloss	**WT**	**Baima**	**Gloss**	**WT**	**Baima**
D	village	*sde*	dê	bottom part	*gdan*	dɛ̀
	tongue	*ljags*	dʒâ	to be green	*ljang* (*ser*)	dʒò(sâ)
	leopard	*gzig*	zî	monastic shawl	*gzan*	zɛ̀
	to find	*rnyed*	ɲᶻê	mountain god	*gnyan*	ɲɛ̀
S(ᶻ)	nose	*sna*	nᶻa̲	to exist	*snang*	nò
	to be lax	*lhod*	jᶻyô	shoes, boots	*lham*	ò
ⁿD(ᶻ)	lips, beak	*mchu*	ⁿdʒᶻû	to jump	*mchong*	ⁿdʒù
	to fly	*'phur*	ᵐbᶻû	to sell (IPFV)	*'tshong*	ⁿdzù

OT origins of historically modal consonants are more numerous and include: (i) OT simplex voiceless unaspirated stops and affricates, (ii) OT simplex voiced stops, affricates, and fricatives, (iii) OT clusters with non-nasal preinitials and voiceless unaspirated stops, affricates, and fricatives, and (iv) OT clusters with nasal preinitials and voiced stops and affricates. Table 9 provides some examples.

Table 9. OT origins of Baima historically modal consonants in Baima

Vowel Consonant	V̲			Vː		
	Gloss	**WT**	**Baima**	**Gloss**	**WT**	**Baima**
T	son	*bu*	pû	daughter	*bu mo*	pō
	animal hair	*spu*	pû	heap, stack	*spungs*	pū
	to itch	*za*	sa̲	cooked rice	*za ma*	sō
	gold	*gser*	sê	hemp	*gso ma*	suɛ̄
S	fish	*nya*	ɲê	to sleep	*nyal*	ɲɛ̄
	year	*lo*	jô	to stand	*lang*	jō
ⁿD	insect	*'bu*	ᵐbû	to be full	*'grangs*	ⁿdz̥ō
	dzo	*mdzo*	ⁿdzô	female dzo	*mdzo mo*	ⁿdzū

Finally, OT origins of Baima voiceless aspirated consonants include: (i) OT simplex voiceless aspirated stops and affricates, and (ii) simplex voiceless unaspirated fricatives, as illustrated in Table 10.

Table 10. OT origins of Baima voiceless aspirated consonants

Vowel Consonant	V̲			V̲ː		
	Gloss	**WT**	**Baima**	**Gloss**	**WT**	**Baima**
T^h	mouth	*kha*	$k^h\underline{a}$	snow	*kha ba*	$k^h\grave{a}$
	hempen cloth	*thags*	$t^h\hat{a}$	rope	*thag pa*	$t^h\grave{a}$
	tooth	*so*	$s^h\hat{e}$	charcoal	*sol*	$s^h\grave{\varepsilon}$
	meat	*sha*	$ʃ^h\underline{a}$	tree, wood	*shing*	$ʃ^h\grave{e}$

Seen in the context of parallel developments of OT onsets in the immediate Tibetic neighbors of Baima (that is, Kun sngon, mBrugchu, and Chos.rje, see Figure 1), the contrast between historically non-modal and modal onsets that underlies phonation contrasts in Baima short and long syllables by and large corresponds to that between breathy vs. non-breathy consonants. This is demonstrated in Table 11, which compares developments of OT onsets in Kun sngon, mBrugchu, and Chos.rje to those in Baima and provides some illustrative examples.

Unique developments in Baima, not paralleled in Kun sngon, mBrugchu, and Chos.rje, include development of a phonation contrast also in OT clusters with nasal preinitials and (voiced and voiceless aspirated) obstruent initials, as compensation for the merger of those OT clusters as prenasalized stops and affricates in Baima. Further developments from Baima historically breathy consonants to modern epiglottalized consonants in short syllables and modal consonants in long syllables are discussed in the following section.

2.2.3 Tonal developments in Baima: A revised analysis

The three contrastive tonal categories in Baima likely developed through an overlay of the phonation distinction in vowels (tense/short/higher-pitched vs. non-tense/long/lower-pitched) and the phonation distinction in consonants (historically non-breathy vs. breathy), as discussed in the previous sections. Resulting changes include development of contrastive epiglottalization in short syllables and that of contrastive modal and breathy-like or lax vowels in long syllables, as summarized in Table 12.

There are two possible chronological orders that would explain the developments in Table 12: (i) the phonation distinction in vowels conditioned by OT rhyme type first vs. (ii) the phonation distinction in consonants (historically breathy vs. non-breathy) conditioned by OT onset developments first. The most plausible order that would provide a phonetically-motivated explanation for the changes in Table 12, is the tense/non-tense distinction developing first, followed by the development of a contrast between breathy and non-breathy consonants. The precise developments are as follows.

Table 11. Developments of OT consonantal onsets in mBrugchu, Kun sngon, Chos.rje, and Baima[20]

OT preinitial	OT initial	mBrugchu	Chos.rje	Baima		Gloss	WT	mBrugchu		Kun sngon	Chos.rje	Baima
		Kun sngon		Short	Long			dGonpa	Ongsum			
Ø-	T^h	T^h [a]	T^h		T^h	he, she, it	*kho*	k^hɤ		k^ha^{55}	k^ho^{53}	$k^hû(ɲə̂)$
	T					pillar	*ka ba*	kɑ ɦa		$kɑ^{55}$	$gaː^{55}$	kɑ̄
	D	T	D [b]		T	tea	*ja*	cɕə	tɕæ	$tɕa^{33}$		tʃâ̤
non-nasal (*r-*, *l-*, *s-*, *g-*, *d-*, *b-*)						to dig (IPFV)	*rko*		^{h}ku		ko^{53}	kô
	T	^{h}T	T		(ʰT >) T [c]	iron	*lcags*	^{h}cɕɑ	^{h}tɕɑ	^{h}tɕɑ^{ʔ51}		tɕâ
						stone	*rdo*	ɦtɤ	ɦdu	ɦdo^{55}		dô
						green	*ljang*			ɦdʒɔ^{55}	tʃɔɦ$ː^{113}$	dʒò
	D	ɦD	DɦV or DVɦ [d]	$D^ʕV̤$	DV̤ː	door	*sgo*		ɦgwə	$ko^{ɦ53}$		gô
nasal (*m-*, *'-*)	D	^{n}D	^{n}DɦV or ^{n}DVɦ		^{n}D	head	*mgo*	ŋgu			^{n}go^{ɦ53}	ŋgô
	T^h	$^nT^h$	T^h	^{n}D$^ʕV̤$	^{n}DV̤ː	lake	*mtsho*	^{n}ts^{h}e (ɦi)	^{n}ʦ^{h}ɤ	^{n}ts^{h}o^{13}	ts^{h}o^{53}	^{n}dz^{ʕ}ô
Ø-		S	S		S	I, 1SG	*nga*		ŋa	ŋa^{55}	ŋɐ^{53}	ŋɑ̄ [e]
non-nasal	S	ɦS	SɦV or SVɦ	$S^ʕV̤$	SV̤ː	five	*lnga*			ɦŋa^{31}	ŋɦɐ^{53}	ŋ^{ʕ}â̤

a. Another source of modern voiceless aspirated initials in Kun sngon, mBrugchu, and Chos.rje includes OT simplex voiceless fricatives, as is also the case in Baima. Examples include: 'heart; mind', WT *sems*, mBrugchu (Ongsum) /ɕ^{h}æ/, Chos.rje /s^{h}eː^{113}/, Baima /s^{h}è/; 'tree; wood', WT *shing*, Kun sngon /x^{h}i^{55}/, mBrugchu (Ongsum) /ɕ^{h}əɣ/, Baima /ʃ^{h}è/.

b. Note that OT simplex voiced obstruents are kept as such in Chos.rje (as in /goˀ 'to hear', from WT *go*), whereas OT simplex voiceless stops and affricates in that variety become voiced (as in /gaː/ 'pillar', from WT *ka ba*) (Sun 2003c: 41).

c. Voiceless preaspiration is occasionally preserved in Baima word-medially, where it can be heard in careful speech. For example, the syllable /kê/ [kê] 'voice, sound', WT *skad*, is realized without preaspiration in isolation, but with preaspiration when part of a disyllabic word, as in [k^{h}ə̤^{h}kê] 'language', WT *kha skad*. A contrastive example without preaspiration is /ùkê/ [ɦùkê], WT *ha ko*; where the word-internal instance of /k/ from OT *k* never surfaces with preaspiration.

d. For Chos.rje, both analyses of reflexes of syllables with OT voiced initials with preinitials in Sun (2003b; 2003c) are provided, that is, (i) a consonantal (segmental) feature (C^{ɦ}V) and (ii) a syllable-level (suprasegmental) feature (CV^ɦ) (see §3.2 for further discussion).

e. The vowel and tone correspondences of the Baima form are irregular. The expected regular form would have been /ŋə̤̂/.

Table 12. Changes to syllable onsets, rhymes, and tones through an overlay of the phonation contrasts in consonants and vowels in Baima

Onset Rhyme	Historically non-breathy			Historically breathy		
	Onset	Rhyme	Tone	Onset	Rhyme	Tone
tense/short/higher-pitched	non-epiglottalized	tense	H	epiglottalized	tense	H
non-tense/long/lower-pitched	plain	modal	M	plain	lax	L

A contrast between epiglottalized and non-epiglottalized onsets in syllables with tense (laryngealized or creaky-like) short vowels likely results from the acoustic and perceptual similarity of breathy-creaky vowels and harsh vowels (as in Baima syllables with epiglottalized onsets). It has been argued (see Garellek 2020 and references therein) that both types of vowels are characterized by high to low H1*-H2*. In breathy-creaky vowels, that is due to a transition from an open-glottis configuration to one with a more closed glottis, whereas in harsh vowels it is a by-product of greater laryngeal constriction. Given this acoustic and perceptual similarity of breathy-creaky and harsh vowels, the development of epiglottalized onsets in Baima syllables with historically breathy onsets is likely a by-product of historically breathy voice, followed by tense voice (laryngealized or creaky phonation of the vowel), that is, ʱC̰V → CˢV̰.

Conversely, a combination of historically breathy onsets with long, relatively laxer vowels likely resulted in the weakening of breathiness on the onset, compensated by an articulatory enhancement of breathy voice on the following vowel (cf. Gao et al. 2021 for a parallel development in Korean). This development yielded plain onsets followed by relatively more breathy vowels, that is, ʱC̰V̤ː → CV̤ː. Triggered by that change, syllables with historically non-breathy onsets and long vowels likely developed a contrastive, more modal vowel quality, that is, CV̰ː → CVː. Finally, given that breathy voice and lowered larynx are auditorily and physiologically related (see Hombert et al. 1979: 47–48; Laver 1980: 31; Esling et al. 2019: 56–58), which facilitates association of breathy syllables with low pitch, long syllables with more breathy vowels became associated with a lower pitch (that is, CV̀ː), whereas long syllables with more modal-like vowels became associated with a higher pitch (that is, CV́ː).

20. Data sources: mBrugchu, Suzuki (2014; 2015a; 2015b); Kun sngon, Hua & Gazangta (1997); Chos.rje, (Sun 2003b; 2003c); Zhongu. For ease of comparison, different conventions for notating voiced preaspiration are unified to a prescript ʱ.

Following the split of long syllables into (i) those with a breathier voice quality and lower pitch and (ii) those with a more modal voice quality and higher pitch, syllables with voiceless aspirated onsets and long vowels joined the former category due to the acoustic and perceptual similarity of aspiration and breathiness, that is, $T^{h}\grave{V}\underline{\underline{:}}$. On common acoustic measures of phonation, vowels tend to be breathier after aspirated consonants (e.g. Ní Chasaide & Gobl 1993; Gobl & Ní Chasaide 1999; Blankenship 2002; Garellek & Keating 2011; Esposito & Khan 2012).

These changes through an overlay of the phonation distinctions in consonants and vowels are schematically presented in Table 13. This table represents a revision of the historical analysis of tonal developments in Huang & Zhang (1995), as summarized in Table 5.

Table 13. Tonal developments in Baima (revised analysis)

Stage 1		Stage 2		Example		
OT rhyme	**Rhyme voice quality**	**Onset voice quality**	**Tone**	**Gloss**	**WT**	**Baima**
		historically non-breathy		to dig (IPFV)	*rko*	kô
-b, *-d*, *-g*	tense	voiceless aspirated	H	mouth	*kha*	$k^{h}\hat{a}$
-r	short			tooth	*so*	$s^{h}\hat{o}$
open	higher-pitched	historically breathy		village	*sde*	dê
				lips; beak	*mchu*	$^{n}dʒ^{ʂ}\hat{u}$
		historically non-breathy	M	pillar	*ka ba*	kā
-m, *-n*, *-ng*,	non-tense	voiceless aspirated		snow	*kha ba*	$k^{h}\grave{a}$
-s, *-l*	long			charcoal	*sol*	$s^{h}\grave{ɛ}$
coalesced syllables	lower-pitched	historically breathy	L	bottom part	*gdan*	dè
				to jump	*mchong*	$^{n}dʒ\grave{u}$

This section revisited the historical analysis of tone in Huang & Zhang (1995) on the basis of the new phonetic and phonological analysis of Baima in Chirkova et al. (2023). It confirmed the chronological order of changes, as proposed by Huang & Zhang (1995). It further suggested (i) a contrast between tenser and laxer sets of vowels with pitch and vowel duration as co-articulated cues as a trigger for the primary tonal split, and (ii) a contrast between historically breathy and

non-breathy onsets as a trigger for the secondary tonal split within the laxer set of vowels. This section also demonstrated, *contrā* Sun (2003), that the correspondences between Baima onsets, rhymes, and tones with WT show a high degree of regularity, hence confirming that Baima is firmly a Tibetic language.

3. A tense/lax distinction in the Tibetic languages neighboring Baima

The development of a tense/lax distinction, as discussed in relation to Baima in § 2, is unusual for a Tibetic language. Nonetheless, it appears to have close parallels in the Tibetic languages neighboring Baima. The Tibetic languages discussed in this section include mBrugchu, Kun sngon, Chos.rje, Zhongu, Thebo, and Cone (see Figure 1), for which phonological sketches and word lists are available. This section first argues for a tense/lax distinction in those languages, conditioned by OT rhyme type (§ 3.1), and then provides an alternative analysis of tonal developments in Chos.je, Thebo, and Cone (§ 3.2).

3.1 Historical developments of OT rhymes in the Tibetic languages neighboring Baima

Vowel developments in the Tibetic languages neighboring Baima are uniform in that they evidence drastic erosion of the original OT rhyme system through loss of the original codas. In Tibetan dialectology, such a drastic rhyme attrition is generally seen as a characteristic development of Kham dialects (e.g. Hu 1991: 193–194; Gesang Jumian & Gesang Yangjing 2002: 78).[21] In fact, OT rhyme simplification in Baima and its neighboring Tibetic languages is even more drastic than that described for Kham dialects. Specifically:

i. The only syllable coda found in Kham dialects — glottal stop, which represents a merger of OT stopped codas (i.e. OT *-b* [p], *-d* [t], *-g* [k] → ʔ) — is further lost in most local languages (Cone, mBrugchu, Zhongu); and it is also progressively lost in different subvarieties of Thebo.[22]

---

21. By contrast, Amdo dialects generally preserve consonantal codas. This can be illustrated with data from Xiahe (bla brang) Tibetan, as described in Renzeng Wangmu (1987). Consider the following examples: /ʰtɕak/ 'iron', WT *lcags*; /kʰap/ 'needle', WT *khab*; /ɦnam/ 'heaven, sky', WT *gnam*; /dən/ 'seven', WT *bdun*; /tɕʰaŋ/ 'beer', WT *chang*; /ɦjar/ 'to borrow', WT *g.yar*.

22. Compare the following words in the Ridwags and Lting.ka varieties of Thebo (data from Renzeng Wangmu 2013 and Lin 2014, respectively): 'panther', WT *gzig*: Ridwags /zi^{51}/, Lting.ka /ziʔ^{L}/; 'eight', WT *brgyad*: Ridwags /dziɛ^{51}/, Lting.ka /dzɛʔ^{L}/; 'needle', WT *khab*: Ridwags /kʰa^{51}/, Lting.ka /kʰoʔ^{H}/.

ii. Vowel nasalization, which commonly develops in OT rhymes with nasal codas (i.e. OT *-m*, *-n*, *-ng* → Ṽ), is lost in all Tibetic languages neighboring Baima, except for Cone and Thebo. In those latter languages, OT syllables with nasal codas yield in part oral vowels, and in part nasal vowels (see Jacques 2014: 292–295 for Cone; Renzeng Wangmu 2013 and Lin 2014 for Thebo). Furthermore, vowel nasalization is also progressively lost in different subvarieties of Thebo.[23]

iii. Similar to Baima, the development of contrastive vowel length in Cone, Thebo, Chos.rje appears correlated with that of tone. The remaining languages are either toneless (Zhongu, see Sun 2003a: 777–779), or have emergent tone (Kun sngon, mBrugchu, see Hua & Gazangta 1997: 183;[24] Suzuki 2015b: 244–246). Vowel developments in the Tibetic languages neighboring Baima are summarized in Table 14a and illustrated with examples in Table 14b.

---

23. Compare the following words in the Lting.ka and Ridwags varieties of Thebo (data from Renzeng Wangmu 2013): 'sun', WT *nyi ma*: Lting.ka /ɲiaŋ^{35}/, Ridwags /ɲiɔ^{35}/; 'plain, flatlands', WT *thang*: Lting.ka /t^{h}aŋ^{35}/, Ridwags /t^{h}ɔ^{55}/; 'meadow', WT *spang*: Lting.ka /paŋ^{55}/, Ridwags /pɔ^{55}/. Note that loss of glottal stop in syllables with OT stopped codas and that of vowel nasalization in syllables with OT nasal codas in different sub-varieties of Thebo are likely correlated, possibly suggesting a more developed contrast between relatively tenser and laxer vowels in some varieties (such as Ridwags) than in others (such as Lting.ka). The relative development of the contrastive vowel types further relates to differences in tonal developments in different sub-varieties of Thebo, as discussed in § 3.2.

24. Hua & Gazangta (1997) describe Kun sngon as having four tones, two of which are high (55, 51), and two are low (31, 13). They note that according to the intuition of native speakers, only the high level and the falling tone(s) are contrastive (Hua & Gazangta 1997: 138). The two falling tones (51, 31) often occur in syllables with OT stopped codas (as in /hto^{ʔ51}/ 'to fold', WT *lteb*; /ɱe^{ʔ31}/ 'lower part', WT *smad*), but they also occur in syllables with OT continuant codas (as in /tsə^{51}/ 'to grind', WT *btsi(r)*; /ɲe^{31}/ 'to listen', WT *nyan*). The remaining two tones (55, 13) often occur in syllables with OT open rhymes (as in /ta^{55}/ 'now', WT *ta*; /^{ɦ}do^{55}/ 'stone', WT *rdo*; /s^{h}ə^{55}/ 'who', WT *su*; /ts^{h}a^{13}/ 'salt', WT *tshwa*; /^{n}ts^{h}o^{13}/ 'to herd', WT *'tsho*), but they also occur in coalesced syllables and syllables with OT continuant codas (as in /q^{h}ɑ^{55}/ 'snow', WT *kha ba*; /t^{h}e^{55}/ WT *than* 'inauspicious sign'; /x^{h}i^{55}/ WT *shing* 'tree'; /^{n}ts^{h}ɑ^{13}/ 'boundary', WT *mtshams*; /^{n}p^{h}ɔ^{13}/ 'spindle', WT *'phang*; /ts^{h}e^{13}/ 'date', WT *tshes*). Put differently, there appears to be no correlation between the four surface tones and the type of modern consonantal onset (e.g. voiceless or voiced, breathy or non-breathy) or the historical origin of the vowel. Furthermore, identical combinations of consonantal onsets and vowels unpredictably occur with both higher and lower tones, as in /^{n}t^{h}o^{55}/ 'to be tall', WT *mtho*, vs. /^{n}ts^{h}o^{13}/ 'lake', WT *mtsho*. Overall, more data and a more detailed phonemic/phonetic analysis would be necessary in order to get a better understanding of the underlying regularities.

Table 14a. Developments of OT rhymes in Baima and its neighboring Tibetic languages

OT rhyme	Baima	Cone	Thebo	Chos.rje	Kun sngon	mBrugchu	Zhongu
-b, -d, -g			V? ~ V	V?	V?		
open			V			V	
-m, -n, -ng, -r, -l, -s			Ṽː ~ Vː				
coalesced syllables			V			V	

As shown in Tables 14a–14b, vowel developments in the Tibetic languages neighboring Baima are by and large similar to those in Baima. This similarity suggests that vowel developments in those former languages are likely governed by the same phonetic processes, as those that have been argued to have led to the development of a tense/lax distinction in Baima in § 2.2.1.

Manifestations of a possible contrast between (a) relatively tenser vowels in syllables with OT open rhymes and rhymes with stopped codas and (b) relatively laxer vowels in coalesced syllables and OT rhymes with continuant codas in Cone, Thebo, Chos.rje appear identical to Baima. They include (i) contrastive vowel duration, and (ii) pitch. Namely, vowels that developed from syllables with OT open rhymes and OT rhymes with stopped codas are short and higher-pitched, whereas vowels that developed from coalesced syllables and syllables OT continuant codas are long and lower-pitched. Across these three languages, correlated differences in vowel duration and pitch can be most clearly observed in syllables with voiceless aspirated obstruent onsets (see examples in Table 14b). That is because such syllables are largely unconcerned by pervasive mergers that in Cone and Thebo affect voiceless unaspirated and sonorant onsets and trigger more complex tonal developments (see in detail below).

Developments in mBrugchu may parallel those in Cone, Thebo, and Chos.rje, as described above. However, available evidence is not altogether conclusive. On the one hand, in her overview of conditions for tone development in Tibetic languages Bufan Huang (1995: 54) describes mBrugchu (her "Zhouqu") as tonal. Furthermore, she describes the same, contrastive tonal developments in syllables with voiceless aspirated onsets in short and long syllables, as those observed in Chos.rje. Namely, syllables that evolved from OT open and stop-final rhymes are higher-pitched, whereas syllables that developed from OT rhymes with continuant codas are lower-pitched. Table 15 reproduces the original examples in Huang (1995: 54).

These developments are identical to those in Baima, Cone, Thebo, and Chos.rje, as discussed presently, and argued to be conditioned by the phonation contrast in vowels (tense vs. lax). However, in a more recent description of

Table 14b. Examples of OT rhyme developments in Baima and its neighboring Tibetic languages[25]

OT rhyme	Gloss	WT	Baima	Cone	Thebo	Chos.rje	Kun sngon	mBrugchu	Zhongu
	poison	*dug*	tŷ	tʉ^{L}	tʊʔ^{L}	dʉʔ^{53}	təʔ^{51}		tə
-b, -d, -g	voice; language	*skad*	kê	kɛ^{H}(lʉ^{H})	keʔ^{H}			^{h}ke	^{h}ki
	needle	*khab*	k^{h}ʉ̂	k^{h}e^{H}	k^{h}oʔ^{H}		k^{h}oʔ^{51}	k^{h}i	k^{h}i
	he, she, it	*kho*	k^{h}û(ɲə̂)	k^{h}o^{51}	k^{h}o^{55}	k^{h}o^{53}		k^{h}ɤ	
open	I, 1SG	*nga*	ŋā	ŋæ^{L}	ŋɑ^{L}	ŋɐ^{53}	ŋa^{55}	ŋa	ŋɐ
	mouth	*kha*	k^{h}a̰	k^{h}æ^{H}	k^{h}ɑ^{H}		k^{h}a^{55}	k^{h}ə	k^{h}ɐ
	door	*sgo*	gə̂	gɔ^{L}	go^{L}	ko^{ɦ53}	^{ɦ}go^{55}	^{ɦ}gwə	go
	chest, box	*sgam* (*bu*)		gæ^{L}(mbə)	-gõː^{L}	kɔː^{ɦ113}			go(^{n}bə)
-m, -n, -ng	lap; bosom	*pang*	põ			bɔː^{55}	pɔ^{55}		pɔ
	marrow; foot	*rkang*	kõ	kɑː^{H}; kæ^{H}wæ	kõ^{H}; kuo^{H}		^{h}kɔ^{55}	^{h}kɔ	^{h}kɔ
-s, -l, -r	to look (PFV)	*bltas*		teː^{H}	tɛː^{H}		^{h}te^{55}		^{h}tɛ
	pillar	*ka ba*	kā	kɑː^{L}	kaː^{L}	gaː^{55}	kɑ^{55}	kɑɦa	ka
coalesced	snow	*kha ba*	k^{h}à	k^{h}ɑː^{L}	k^{h}aː^{L}		q^{h}ɑ^{55}		q^{h}a
syllable	house	*khang ba*	^{ŋ}gò	k^{h}æ^{L}wæ	k^{h}o^{L}wa	k^{h}ɔː^{113}	nk^{h}ɔ^{55}		^{n}k^{h}ɔ

25. Data sources: Cone, Qu (1962), Jacques (2014); Thebo, Renzeng Wangmu (2013), Lin (2014); Chos.rje, Sun (2003b); Kun sngon, Hua & Gazangta (1997); mBrugchu Suzuki (2014; 2015a; 2015b); Zhongu, Sun (2003a). In Cone and Thebo, tone notations with superscript ^{H}/$_{L}$ are from Jacques (2014) and Lin (2014); tone notations with Yuen Ren Chao's tone numbers are from Qu (1962) and Renzeng Wangmu (2013).

Table 15. Tonal developments in syllables with voiceless aspirated onsets in mBrugchu and Chos.rje

Gloss	WT	mBrugchu	Chos.rje
to drink	*'thung*	t^hu^{12}	t^hu^{112}
snow	*kha ba*	k^ha^{121}	k^ha^{112}
beer	*chang*	$tɕ^huɔ^{12}$	$tɕ^hɔ^{112}$
nest	*tshang*	$ts^huɔ^{12}$	$ts^hɔ^{112}$

mBrugchu by Hiroyuki Suzuki (2015b: 244–246), syllables with voiceless aspirated onsets are said to always be high-toned irrespective of the historical origin of the vowel. Hence, additional data would be necessary to assess the degree of similarity of tonal developments in mBrugchu to those in Baima, Cone, Thebo, and Chos.rje.

Manifestations of a possible tense/lax distinction in the Tibetic languages neighboring Baima that are toneless (Zhongu) or have emergent tone (Kun sngon) appear to implicate vowel quality rather than vowel duration and/or pitch. Specifically, vowels that evolved from OT open rhymes and rhymes with stopped codas tend to be higher and more advanced. On the other hand, vowels that evolved from coalesced syllables or OT rhymes with continuant codas tend to be lower and more retracted. Consider the following examples of contrastive vowel pairs in Zhongu: /ⁿdzɐ̯/ 'demon' (WT *'dre*) - /ⁿdzɛ̯/ 'rice' (WT *'bras*); /lo/ 'year' (WT *lo*) - /lɔ/ 'road' (WT *lam*) (Sun 2003a: 777, 790). The division of vowels into two sets in Zhongu and Kun sngon is arguably less clear-cut than in Baima or Cone.

In sum, while existing descriptions of the Tibetic languages neighboring Baima do not expressly mention phonation,[26] they do offer examples of characteristic developments that are suggestive of a similar type of phonation contrasts triggered by the same environments as in Baima (that is, OT open and checked syllables vs. coalesced and smooth syllables). Correlation of the contrast with pitch in some languages (such as Chos.rje, Cone, and Thebo) likely played an important role in their tonal developments, as discussed in the following section.

26. This is perhaps unsurprising, given that both tense and lax categories may not be very different from modal voice (as they are in some Yi languages, e.g. Kuang & Keating 2014). Alternatively, that can also be taken as making no claim regarding phonation.

3.2 Tonal developments in the Tibetic languages neighboring Baima: An alternative analysis

Existing descriptions of Chos.rje (Sun 2003b; 2003c: 41–42) analyze it as having phonetic-level "habitual" tone rather than phonemic tone. Chos.rje monosyllables are described as generally spoken on a high register (including those with voiced onsets), whereas syllables with long rhymes and aspirated or breathy initials as being predictably low. Examples include: /go^{53}/ 'to hear' (WT *go*), /gɔː^{55}/ 'glacier' (WT *gangs*), /kʰo^{53}/ 'he, she, it' (WT *kho*), /kʰɔː^{113}/ 'house' (WT *khang ba*).

Thebo and Cone, on the other hand, are analyzed as having "partial tone systems" (cf. Lin 2014: 223 for Thebo). In such a system, tone is said to be only contrastive in syllables with voiceless unaspirated obstruent and sonorant onsets (e.g. Jacques 2014: 284–286 for Cone; Lin 2014: 243–244 for Thebo) (see Table 17 for examples). Tonal developments in those syllables have been demonstrated to follow common tonogenetic pathways in Tibetic languages, viz., OT onset devoicing and cluster reduction. Conversely, in syllables with voiceless aspirated initials, tone is described as predictable on syllable length. It is high in short syllables and low in long syllables (as is also the case in Chos.rje). In syllables with voiced initials, on the other hand, tone is described as varying from predictably low, irrespective of vowel length (as in Cone, Jacques 2014: 285), to always low in syllables with long vowels, but variably high and low in syllables with short vowels (as appears to be the case in various subvarieties of Thebo, as described in Renzeng Wangmu 2013 and Lin 2014). Hence, Ridwags is described as more consistently high-toned in syllables with voiced obstruent onsets and short vowels than Lting.ka. Compare the following words in those two varieties: 'tongue', WT *ljags*: Ridwags /dʑɒ^{51}/, Lting.ka /dʒaʔ^{L}/; 'color', WT *mdog (kha)*: Ridwags /do^{51}/, Lting.ka /^{n}do^{L}ɣɑ/; 'eight', WT *brgyad*: Ridwags /dzie^{51}/, Lting.ka /dzɛʔ^{L}/; 'thunder; dragon', WT *'brug*: Ridwags /dʑu^{51}/, Lting.ka /^{n}dʑʊʔ^{L}/.

The existing analyses of Chos.rje, Thebo, and Cone, while insightful, do not address the phonetic reasons for the observed correlation between syllable length and pitch, in particular in syllables with voiceless aspirated onsets, and the variability of tone in syllables with voiced initials. Tonal developments, as observed in Chos.rje, Thebo, and Cone, prompted Jackson T.-S. Sun (2003c: 40–43) in his overview of tonal developments in Tibetic languages to include rhyme length and onset aspiration as innovative pathways leading to distinctive low register. At the same time, Sun notes that these pathways have unclear underlying phonetic mechanisms, while Tibetic languages also commonly evidence contrary developments. A phonetically-motivated explanation for these unusual developments becomes possible if these are analyzed as associated with a tense/lax vowel distinction, as argued for those languages in the present study. The specific developments can be outlined as follows.

Tonal developments in Chos.rje, which shares with Baima a contrast between breathy and non-breathy consonants, are identical to Baima (as described in § 2.2.3). The primary division between higher-pitched and lower-pitched syllables is induced by OT rhyme type. Syllables with tense, short vowels, which evolved from OT open syllables and syllables with stopped codas, became associated with a higher pitch (53 in Sun's 2003b notation), irrespective of the phonation type of the consonantal onset (breathy and non-breathy). On the other hand, syllables with non-tense, long vowels, which evolved from OT coalesced syllables and syllables with continuant codas, became associated with a lower pitch. Depending on the phonation type of the consonantal onset (breathy or non-breathy), syllables with non-tense, long vowels split into those with a breathy voice quality and lower pitch (113 in Sun's 2003b notation), and those with a modal voice quality and higher pitch (55 in Sun's (2003b) notation). Finally, syllables with voiceless aspirated onsets and long vowels joined the former syllables in acquiring the low tone (113). These developments are summarized in Table 16.

Table 16. Tonal developments in Chos.rje

Stage 1		**Stage 2**		**Example**		
OT rhyme	**Phonation**	**Chos.rje onset**	**Tone**	**Gloss**	**WT**	**Chos.rje**
		non-breathy		to dig (IPFV)	*rko*	ko
				to hear	*go*	go
-b, -d, -g,	tense	voiceless aspirated	53	he, she, it	*kho*	kʰo
-r	short			want	*dgo(s)*	kʱo
open	higher-pitched	breathy		lake	*mtsho*	tsʰo
				head	*mgo*	ŋgʱo
				green/blue	*sngo*	ŋʱo
		non-breathy		pillar	*ka ba*	ga:
-m, -n, -ng,			55	glacier	*gangs*	gɔ:
-s, -l, -r	lax			house	*khang ba*	kʰɔ:
coalesced	long	voiceless aspirated		heart; mind	*sems*	sʰe:
syllables	lower-pitched		113	to drink	*'thung*	tʰu:
		breathy		chest, box	*sgam*	kɔ:ʱ

In similar fashion, the primary division between higher-pitched and lower-pitched syllables in Thebo and Cone is likely originally associated with a tense/lax vowel distinction, induced by OT rhyme type. Their differences from tonal developments in Chos.rje, namely the High-Low register split in syllables with voiceless unaspirated and sonorant onsets, essentially relate to different developments of OT onsets. Specifically, all OT preinitials, but nasal preinitials before OT voiced stops and affricates, disappeared in Thebo and Cone. This led to mergers

of (i) OT simplex voiced obstruents and OT voiceless unaspirated obstruents with preinitials to voiceless unaspirated obstruents, and (ii) OT simplex sonorants and OT sonorants with preinitials to sonorants. Mergers in syllables with those onsets were compensated for by the development of High-Low tonal contrasts in both short and long syllables. The variegated developments in syllables with voiced initials in Ridwags and Ling.ka can be explained as follows. Recall that Ridwags evidences a more pervasive loss of glottal stop coda and vowel nasalization than Lting.ka, thereby suggesting a more developed contrast between tenser and laxer vowels (see examples in Footnotes 22 and 23). In the analysis proposed in the present study, these variegated developments can be interpreted as showing competing tendencies to correlate the tone of the syllable with either the phonation type of the vowel (higher pitch predictable from a tenser short vowel in Ridwags) or with the syllable onset (lower pitch predictable from a voiced onset in Lting.ka, and also in Cone). These developments are summarized and illustrated with examples in Table 17.

This section discussed the historical developments of OT rhymes in the Tibetic languages neighboring Baima. It proposed an alternative analysis of tonal developments in Chos.rje, Thebo, and Cone providing phonetically motivated explanations for some unusual developments involving rhyme length and onset aspiration that are not addressed in detail in the existing descriptions of those languages.

This section also demonstrated that despite their apparent diversity, the Tibetic languages neighboring Baima (that is, northeastern Tibetic languages) likely share with Baima one distinct development that sets them apart from other Tibetic languages: a tense/lax distinction conditioned by OT rhyme type. This development can be tentatively proposed as a diagnostic feature pointing to a period of common history between these northeastern Tibetan languages. It potentially lends support to considering Baima, Chos.rje, Thebo, Cone, and possibly also mBrugchu, Zhongu, and Kun sngon, as constituting a valid subset of languages within the Tibetic language family. This subset was suggested by Tournadre (2013), who calls it the Eastern section of the Tibetic language family.

4. Tonal developments in Baima in an areal context

The development of a tense/lax distinction, as argued for local Tibetic languages of northern Sichuan and southern Gansu, is uncommon in Tibetic languages. A possible explanation for such a development may be sought in the historically multilingual area where those Tibetic languages are spoken and which is home also to non-Tibetic languages. These include the immediate neighbor of Baima

Table 17. Tonal developments in Thebo and Cone[27]

Stage 1		Stage 2			Example		
OT rhyme	**Phonation**	**Thebo/Cone onset**		**Gloss**	**WT**	**Thebo**	**Cone**
		T	(H ← OT voiceless unaspirated obstruent with preinitial)	animal hair	*spu*	pə^{H}	pə^{H}
			(L ← OT simplex voiced obstruent)	son	*bu*	pə^{L}	pə^{L}
-b, -d, -g	tenser	T^{h} (H, unchanged from stage 1)		needle	*khab*	k^{h}oʔ^{H}	k^{h}e^{H}
open	shorter	D/^{n}D (variably H, unchanged from stage 1; or L)		eight	*brgyad*	dzɛʔ^{L}/dziɛ^{51}	dʑe^{L}
	higher-pitched	S	(H ← OT sonorant with preinitial)	five	*lnga*	ŋa^{H}	ŋæ^{H}
			(L ← OT simplex sonorant)	I, 1SG	*nga*	ŋa^{L}	ŋæ^{L}
		T	(H ← OT voiceless unaspirated obstruent with preinitial)	gold	*gser*	seː^{H}	ser^{H}
-m, -n, -ng,			(L ← OT simplex voiced obstruent)	to eat (PFV)	*zos*	seː^{L}	sɪː^{L}
-s, -l, -r	laxer	T^{h} (L, unchanged from stage 1)		snow	*kha ba*	k^{h}aː^{L}	k^{h}ɑː^{L}
coalesced	longer	D/^{n}D (L, unchanged from stage 1)		flea	*lji ba*	dʒɑː^{L}, dʒeː^{L}/dʑa^{35}	dɯː^{L}
syllables	lower-pitched	S	(H ← OT sonorant with preinitial)	bamboo	*smyug ma*	ɲiː^{H}wãː^{H}	ɲiː^{H}wãː^{H}
			(L ← OT simplex sonorant)	sun	*nyi ma*	ɲõ^{L}	ɲə^{L}wãː^{H}

27. Data sources: Thebo: Renzeng Wangmu (2013), Lin (2014); Cone: Jacques (2014). Tone notations with superscript $^{H/L}$ are from Lin (2014) and Jacques (2014). Tone notations with superscript $^{H/L}$ are from Lin (2014) and Jacques (2014).

the Qiang language, as well as Rgyalrongic languages (Rgyalrong, Horpa, Khroskyabs). An important recent discovery in the area is that local non-Tibetic languages feature contrasts between paired sets of vowels, of which one is plain and the other is associated with secondary articulatory gestures (variously described as velarization, uvularization, and pharyngealization) (Evans 2006a, 2006b; Lin et al. 2012; Sun & Evans 2013; Evans et al. 2016; Van Way 2018; Chiu & Sun 2020). Vowels in the latter set have been demonstrated to have raised F1 and lowered F2 values, as compared to their counterparts in the former, plain set, hence suggesting a greater retraction and lowering of the tongue for the former set.[28] The division of vowels into two sets correlated with tongue lowering and retraction is in turn, strongly suggestive of a parallel engagement of larynx opening and larynx height through synergistic relations in the lower vocal tract (see Esling 1996, 2005; Edmondson et al. 2001; Edmondson & Esling 2006; Esling et al. 2019: 101–105, 164–166; Moisik et al. 2021). In other words, the recently uncovered contrasts between paired sets of vowels likely reflect a basic register-based or voice quality contrast in local non-Tibetic languages (see Chirkova 2024 for discussion). It is noteworthy that manifestations of that contrast in different subvarieties of each language where it has been attested, are variegated, including in addition to differences in vowel quality, also differences in pitch (as in different non-tonal and tonal varieties of the Qiang language, see Sims 2022 for a recent analysis). This diversity of correspondence can be attributed to the fact that voice articulation, acoustics, and perception are inherently multidimensional and realized with multiple covarying cues, hence opening up the possibility of sound change due to cue shifting in production and perception (e.g. Kuang & Cui 2018). Against this background, the innovative development of two sets of vowels associated with phonation, pitch, and vowel duration in local Tibetic languages may be interpreted as approximating the basic voice quality contrast in local non-Tibetic languages. Furthermore, parallel development of voice quality contrasts in the local language clusters that are genetically distinct (non-Tibetic, Tibetic) can be taken to suggest that it may be an areal feature that diffuses across genetic boundaries.

At this stage of our knowledge of local languages these suggestions are but tentative. Much additional, instrumental work is required to understand the exact nature of contrastive categories associated with differences in phonation, pitch, vowel duration, and vowel quality in various languages of the historically multiethnic and multilingual area where Baima is spoken. The significance of the

28. Incidentally, these characteristics of the paired sets of vowels in local non-Tibetic languages are similar to those of contrastive sets of vowels in Northern Yi (see § 2.2.1) and Zhongu (see § 3.1).

Baima case is in offering evidence for the development of voice quality contrasts also in local Tibetic languages, hence contributing to a more comprehensive assessment of the possible origins and diffusion of those contrasts in various languages of northern Sichuan.

Acknowledgements

An earlier version of this paper was presented at the Sixth Workshop on Sino-Tibetan Languages of Southwest China (STLS-2021), Kobe, Japan, 7–11 September 2021. I am grateful for the feedback I received following that presentation.

I would like to express my gratitude to Ryan Gehrmann, Cathryn Yang, and the editors and anonymous reviewers of *Language and Linguistics* for their helpful comments on earlier drafts of the paper. I would also like to thank Paul van Els for creating the map in Figure 1 and Jenny Tzu-Chun Chen for her meticulous proofreading of the manuscript before publication.

List of abbreviations

D	voiced obstruent
IPFV	imperfective
^{N}D	prenasalized stop or affricate
OT	Old Tibetan
PFV	perfective
S	sonorant
SG	singular
Sfi	breathy sonorants
T	voiceless unaspirated obstruent
T^{h}	voiceless aspirated obstruent
WT	Written Tibetan

References

Awang Cuocheng & Wang, Jianmin. 1988. Baima Zangzu yuyan diaocha jishi. *Xinan Minzu Xueyuan Xuebao (Zhexue Kexue Ban)* 6. 11–32, 58.

Blankenship, Barbara. 2002. The timing of nonmodal phonation in vowels. *Journal of Phonetics* 30(2). 163–191.

Bradley, David. 1979. *Proto-Loloish*. London: Curzon Press.

Bradley, David. 1982. Register in Burmese. In Bradley, David (ed.), *Papers in South-East Asian linguistics, volume 8: Tonation* (Pacific Linguistics Series A-62), 117–132. Canberra: The Australian National University.

Chirkova, Katia. 2024. Vowel harmony in Sino-Tibetan languages. In van der Hulst, Harry & Ritter, Nancy A. (eds.), *The Oxford handbook of vowel harmony*, 729–740. Oxford: Oxford University Press.

Chirkova, Katia & Kocjančič Antolík, Tanja & Amelot, Angélique. 2023. Baima. *Journal of the International Phonetic Association* 53(2). 547–576.

Chiu, Chenhao & Sun, Jackson T.-S. 2020. On pharyngealized vowels in Northern Horpa: An acoustic and ultrasound study. *The Journal of the Acoustical Society of America* 147(4). 2928–2946.

DiCanio, Christian T. 2012. Coarticulation between tones and glottal consonants in Itunyoso Trique. *Journal of Phonetics* 40(1). 162–176.

Edmondson, Jerold A. & Lama Ziwo & Esling, John H. & Harris, Jimmy G. & Li, Shaoni. 2001. The aryepiglottic folds and voice quality in the Yi and Bai languages: Laryngoscopic case studies. *The Mon-Khmer Studies Journal* 31. 83–100.

Edmondson, Jerold A. & Esling, John H. 2006. The valves of the throat and their functioning in tone, vocal register and stress: Laryngoscopic case studies. *Phonology* 23(2). 157–191.

Edmondson, Jerold A. & Esling, John H. & Lama Ziwo. 2017. Nuosu Yi. *Journal of the International Phonetic Association* 47(1). 87–97.

Esling, John H. 1996. Pharyngeal consonants and the aryepiglottic sphincter. *Journal of the International Phonetic Association* 26(2). 65–88.

Esling, John H. 2005. There are no back vowels: The laryngeal articulator model. *Canadian Journal of Linguistics* 50(1-4). 13–44.

Esling, John H. & Edmondson, Jerold A. 2002. The laryngeal sphincter as an articulator: Tenseness, tongue root and phonation in Yi and Bai. In Braun, Angelika & Masthoff, Herbert R. (eds.), *Phonetics and its applications: Festschrift for Jens-Peter Köster on the occasion of his 60th birthday*, 38–51. Stuttgart: Franz Steiner Verlag.

Esling, John H. & Moisik, Scott R. & Benner, Allison & Crevier-Buchman, Lise. 2019. *Voice quality: The laryngeal articulator model*. Cambridge: Cambridge University Press.

Esposito, Christina M. & Khan, Sameer ud Dowla. 2012. Contrastive breathiness across consonants and vowels: A comparative study of Gujarati and White Hmong. *Journal of the International Phonetic Association* 42(2). 123–143.

Evans, Jonathan P. 2006a. Vowel quality in Hongyan Qiang. *Language and Linguistics* 7(4). 731–754.

Evans, Jonathan P. 2006b. Origins of vowel pharyngealization in Hongyan Qiang. *Linguistics of the Tibeto-Burman Area* 29(2). 91–123.

Evans, Jonathan P. & Sun, Jackson T.-S. 2015. Qiāng 羌 language. In Sybesma, Rint & Behr, Wolfgang & Gu, Yueguo & Handel, Zev & Huang, C.-T. James & Myers, James (eds.), *Encyclopedia of Chinese language and linguistics*. Leiden: Brill. (https://referenceworks.brill.com/display/entries/ECLO/COM-00000347.xml?ebody=full-html) (Accessed 2023-09-19.)

Evans, Jonathan P. & Sun, Jackson T.-S. & Chiu, Chenhao & Liou, Michelle. 2016. Uvular approximation as an articulatory vowel feature. *Journal of the International Phonetic Association* 46(1). 1–31.

Gao, Jiayin & Yun, Jihyeon & Arai, Takayuki. 2021. Korean laryngeal contrast revisited: An electroglottographic study on denasalized and oral stops. *Laboratory Phonology* 12(1). 1–29. (Article 7.)

Garellek, Marc. 2019. The phonetics of voice. In Katz, William F. & Assmann, Peter F. (eds.), *The Routledge handbook of phonetics*, 75–106. New York: Routledge.

Garellek, Marc. 2020. Acoustic discriminability of the complex phonation system in !Xóõ. *Phonetica* 77(2). 131–160.

Garellek, Marc. 2022. Theoretical achievements of phonetics in the 21st century: Phonetics of voice quality. *Journal of Phonetics* 94. 1–22. (Article 101155.)

Garellek, Marc & Keating, Patricia. 2011. The acoustic consequences of phonation and tone interactions in Jalapa Mazatec. *Journal of the International Phonetic Association* 41(2). 185–205.

Garellek, Marc & Ritchart, Amanda & Kuang, Jianjing. 2016. Breathy voice during nasality: A cross-linguistic study. *Journal of Phonetics* 59. 110–121.

Gesang Jumian & Gesang Yangjing. 2002. *Zangyu fangyan gailun*. Beijing: The Ethnic Publishing House.

Gobl, Christer & Ní Chasaide, Ailbhe. 1999. Voice source variation in the vowel as a function of consonantal context. In Hardcastle, William J. & Hewlett, Nigel (eds.), *Coarticulation: Theory, data and techniques*, 122–143. Cambridge: Cambridge University Press.

Gruber, James Frederick. 2011. *An articulatory, acoustic, and auditory study of Burmese tone*. Washington: Georgetown University. (Doctoral dissertation.)

Hombert, Jean-Marie & Ohala, John J. & Ewan, William G. 1979. Phonetic explanations for the development of tones. *Language* 55(1). 37–58.

Hu, Tan. 1991. Zangyu. In Ma, Xueliang & Hu, Tan & Dai, Qingxia & Huang, Bufan & Wang, Tianxi & Xing, Gong-wan & Chen, Qiguang & Ni, Dabai (eds.), *A general introduction to Sino-Tibetan languages*, vol. 2, 109–207. Beijing: Peking University Press.

Hua, Kan & Gabzangtar. 1997. The historical evolution of the sound system and phonetic of Songpan dialect of Tibetan language. *Zhongguo Zangxue* 1997(2). 134–150.

Huang, Bufan. 1995. Conditions for tonogenesis and tone split in Tibetan dialects. *Linguistics of the Tibeto-Burman Area* 18(1). 43–62. (Translated by Jackson T.-S. Sun.)

Huang, Bufan & Zhang, Minghui. 1995. A study on the classification of Pema language. *Zhongguo Zangxue* 1995(2). 79–118.

Jacques, Guillaume. 2014. Cone. In Sun, Jackson T.-S. (ed.), *Phonological profiles of little-studied Tibetic varieties*, 269–375. Taipei: Institute of Linguistics, Academia Sinica.

Klatt, Dennis H. & Klatt, Laura C. 1990. Analysis, synthesis, and perception of voice quality variations among female and male talkers. *The Journal of the Acoustical Society of America* 87(2). 820–857.

Kuang, Jianjing. 2011a. *Production and perception of the phonation contrast in Yi*. Los Angeles: University of California, Los Angeles. (Master's thesis.)

Kuang, Jianjing. 2011b. Phonation contrast in two register contrast languages and its influence on vowel quality and tone. In Lee, Wai-Sum & Zee, Eric (eds.), *Proceedings of the 17th International Congress of Phonetic Sciences (ICPhS XVII)*, 1146–1149. Hong Kong: City University of Hong Kong. (https://www.internationalphoneticassociation.org/icphs-proceedings/ICPhS2011/OnlineProceedings/RegularSession/Kuang/Kuang.pdf) (Accessed 2024-09-13.)

Kuang, Jianjing & Keating, Patricia. 2014. Vocal fold vibratory patterns in tense versus lax phonation contrasts. *The Journal of the Acoustical Society of America* 134(5). 2784–2797.

Kuang, Jianjing & Cui, Aletheia. 2018. Relative cue weighting in production and perception of an ongoing sound change in Southern Yi. *Journal of Phonetics* 71. 194–214.

Ladefoged, Peter. 1973. The features of the larynx. *Journal of Phonetics* 1(1). 73–83.

Laver, John. 1980. *The phonetic description of voice quality*. Cambridge: Cambridge University Press.

Lin, You-Jing. 2014. Thebo. In Sun, Jackson T.-S. (ed.), *Phonological profiles of little-studied Tibetic varieties*, 215–267. Taipei: Institute of Linguistics, Academia Sinica.

Lin, You-Jing & Sun, Jackson T.-S. & Chen, Alvin C. 2012. An acoustic study of the velarization contrast in Puxi Shangzhai. *Yuyanxue Luncong* 45. 187–195.

Maddieson, Ian & Ladefoged, Peter. 1985. "Tense" and "lax" in four minority languages of China. *Journal of Phonetics* 13(4). 433–454.

Moisik, Scott R. & Czaykowska-Higgins, Ewa & Esling, John H. 2021. Phonological potentials and the lower vocal tract. *Journal of the International Phonetic Association* 51(1). 1–35.

Ní Chasaide, Ailbhe & Gobl, Christer. 1993. Contextual variation of the vowel voice source as a function of adjacent consonants. *Language and Speech* 36(2-3). 303–330.

Nishida, Tatsuo & Sun, Hongkai. 1990. *A study of the Baima-Chinese vocabulary*. Kyoto: Shokado.

Ohala, John J. & Ohala, Manjari. 1993. The phonetics of nasal phonology: Theorems and data. In Huffman, Marie K. & Krakow, Rena A. (eds.), *Nasals, nasalization, and the velum*, 225–249. San Diego: Academic Press.

Qu, Aitang. 1962. Zhuoni Zangyu de shengdiao yu shengyunmu de guanxi. *Zhongguo Yuwen* 1962(7). 334–339.

Qu, Aitang. 1991. *Zangyu yunmu yanjiu*. Xining: Qinghai Nationalities Press.

Renzeng Wangmu. 1987. The phonetic correspondence between Xiahe speech and Tibetan written language. *Minzu Yuwen* 1987(6). 46–53.

Renzeng Wangmu. 2013. *Diebu Zangyu yanjiu*. Beijing: Minzu University of China Press.

Sims, Nathaniel A. 2022. Tone and vowel uvularity in Rma. *Cahiers de Linguistique - Asie Orientale* 51(2). 209–222.

Sun, Hongkai. 1980. Baima ren de yuyan. In Sichuan Institute of Minority Nationalities (ed.), *Baima Zangren zushu wenti taolunji*, 15–25. Chengdu: Sichuan Nationalities Research Center.

Sun, Hongkai. 2003. Is Baima a dialect or vernacular of Tibetan? *Cahiers de Linguistique - Asie Orientale* 32(1). 61–81.

Sun, Hongkai & Chirkova, Katia & Liu, Guangkun. 2007. *Baimayu yanjiu*. Beijing: The Ethnic Publishing House.

Sun, Jackson T.-S. 2003a. Phonological profile of Zhongu: A new Tibetan dialect of Northern Sichuan. *Language and Linguistics* 4(4). 769–836.

Sun, Jackson T.-S. 2003b. Sound features in Tibetan dialect Chosrje. *Minzu Yuwen* 2003(6). 1–6.

Sun, Jackson T.-S. 2003c. Variegated tonal developments in Tibetan. In Bradley, David & LaPolla, Randy J. & Michailovsky, Boyd & Thurgood, Graham (eds.), *Language variation: Papers on variation and change in the Sinosphere and in the Indosphere in honour of James A. Matisoff*, 35–51. Canberra: Pacific Linguistics.

Sun, Jackson T.-S. 2006. Special linguistic features of gSerpa Tibetan. *Linguistics of the Tibeto-Burman Area* 29(1). 107–126.

Sun, Jackson T.-S. 2007. Perfective stem renovation in Khalong Tibetan. In Bielmeier, Roland & Haller, Felix (eds.), *Linguistics of the Himalayas and beyond*, 323–340. Berlin: Mouton de Gruyter.

Sun, Jackson T.-S. & Evans, Jonathan P. 2013. Mawo Qiangyu yuanyin yinxi zaitan. In Shi, Feng & Peng, Gang (eds.), *Eastward flows the great river: Festschrift in honor of Professor William S-Y. Wang on his 80th birthday*, 135–151. Kowloon: City University of Hong Kong Press.

Suzuki, Hiroyuki. 2014. mBrugchu Tibetan Ongsum dialect phonetic description and dialectal comparison. *Journal of Asian and African Studies* 87. 241–263.

Suzuki, Hiroyuki. 2015a. New perspectives on the suprasegmentals in mBrugchu Tibetan: An introduction to the tonogenesis triggered by breathy voice. *Bulletin of Chinese Linguistics* 8(1). 117–139.

Suzuki, Hiroyuki. 2015b. Esquisse phonétique du tibétain de dGonpa: un dialecte parlé à mBrugchu. *Revue d'Etudes Tibétaines* 33. 231–249.

Thurgood, Graham. 2017. Sino-Tibetan: Genetic and areal subgroups. In Thurgood, Graham & LaPolla, Randy J. (eds.), *The Sino-Tibetan languages*, 2nd edn., 3–39. London: Routledge.

Tournadre, Nicolas. 2013. The Tibetic languages and their classification. In Owen-Smith, Thomas & Hill, Nathan W. (eds.), *Trans-Himalayan linguistics: Historical and descriptive linguistics of the Himalayan area*, 105–129. Berlin: Mouton de Gruyter.

Van Way, John. 2018. *The phonetics and phonology of Nyagrong Minyag, an endangered language of Western China*. Honolulu: University of Hawai'i at Mānoa. (Doctoral dissertation.)

Wylie, Turrell. 1959. A standard system of Tibetan transcription. *Harvard Journal of Asiatic Studies* 22. 261–267.

Zhang, Jichuan. 1994a. Baima speech and Tibetan language. *Minzu Yuwen* 1994(2). 11–24.

Zhang, Jichuan. 1994b. Baima speech and Tibetan language (continued). *Minzu Yuwen* 1994(3). 53–67.

Zhang, Jichuan. 1997. Particularités phonétiques du Baima. *Cahiers de Linguistique - Asie Orientale* 26(1). 131–153.

Address for correspondence

Katia Chirkova
CRLAO-EHESS-INALCO
Campus Condorcet
5 cours des Humanités n°5181
93322 Aubervilliers cedex
France

katia.chirkova@gmail.com
https://orcid.org/0000-0001-9960-504X

Publication history

Date received: 12 June 2022
Date accepted: 20 August 2023
Published online: 7 March 2025