

Supplementary material for *Lenition alternation in West Gyalrongic and its implication for Southeast Asian panchronic phonology*

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1 Introduction

The present supplementary material is structured as follows. Section 2 presents background information about Khroskyabs historical phonology. Section 5 presents a comparison of inflectional and derivational prefixes between East and West-Gyalrongic languages. Section 6 presents lenition discrepancies between Khroskyabs and other West-Gyalrongic languages, discussing cases where Khroskyabs has lenition, while others do not, or *vice-versa*. Section 7 accounts for the exceptions to the morphophonological reconstructions proposed in the paper. Section 8 presents a Python code to test sound changes proposed in the main article. The Python code is attached at the end of the material.

2 Some preliminaries to Khroskyabs historical phonology

2.1 Khroskyabs velarisation and the reconstruction of rhymes

Two papers are dedicated to the reconstruction of Proto-Khroskyabs rhymes, [Lai \(2021b\)](#) and [Lai \(forthcoming\)](#), both postulating that velarisation is mainly respon-

sible for vowel quality splits from Proto-Khroskyabs to Modern dialects.

Table 1 summarises the sound changes from Proto-Khroskyabs rhymes to Modern Siyuewu ones.

Final		Non-final	
Reconstruction	Modern Siyuewu	Reconstruction	Modern Siyuewu
*-i ^(Y)	-i ^(Y) (?)	*-i ^(Y) -	-i-
*-æ	-i	*-æ-	-æ-
*-æ ^Y	-a	*-æ ^Y -	-a-
*-e	-e	*-e-	-æ-
*-ə	-ə	*-ə-	-æ-
*-ə ^Y	-o	*-ə ^Y -	-ə- (before -m), -o-
*-u	-u	*-u-	*-o- > -æ-
*-u ^Y	-u	*-u ^Y -	*-o ^Y - > -o-
*-u	-ə	*-u-	-ə-
*-u ^Y	-u	*-u ^Y -	-ə-
*-u ^(Y)	-u ^(Y) (?)	*-u ^(Y) -	-u-
*-o	e	*-o-	-æ-
*-o ^Y	-o	*-o ^Y -	-ə- (before -m), -o-

Table 1: Summary of Proto-Khroskyabs's internal reconstruction

2.2 Prenasalisation in Proto-Khroskyabs

Anticausative voicing alternation is found in many Sino-Tibetan languages. It involves verb pairs with one voiceless-initialed counterpart denoting a causative meaning, and the other, voiced-initialed, denoting an anticausative meaning. It is often referred to as 清濁別義 *qīng zhuó bié yì* ‘semantic distinction through voicing alternation’ in Middle Chinese, such as 敗 *pàj* ‘defeat’ vs 敗 *bàj* ‘be defeated’ and 折 *tçet* ‘break (tr)’ vs 折 *dçet* ‘break (intr)’.

In many languages, the alternation is between a plain voiceless initial and a plain voiced initial. However, in East-Gyalrongic languages, the voiced counterpart is systematically prenasalised, as shown in Table 2 for Japhug (Jacques 2015a).

Table 2: Anticausative derivation in Japhug

Causative	Anticausative
<i>plut</i> ‘destroy’	<i>mblut</i> ‘be destroyed’
<i>tʂaβ</i> ‘cause to fall/roll’	<i>ndzaβ</i> ‘fall/roll’
<i>fʂi</i> ‘melt’	<i>ndzi</i> ‘melt’
<i>cw</i> ‘open (tr)’	<i>ɲɯ</i> ‘open (intr)’
<i>kra</i> ‘cause to fall’	<i>ŋgra</i> ‘fall’
<i>qrw</i> ‘break (tr)’	<i>NGrw</i> ‘break (intr)’

Anticausative prenasalisation in East-Gyalrongic coincides with the reconstruction of Old Chinese for the same phenomenon (Sagart and Baxter 2012, Baxter and Sagart 2014), therefore 敗 *bəj* ‘be defeated’ is derived from its voiceless counterpart through a detransitivising nasal prefix: $*N-p^r[ra[t]-s > *b^r[ra[t]-s > bəj$.

Anticausative derivations in West-Gyalrongic languages do not involve prenasalisation (Gates et al. forthcoming). Table 3 shows some examples in Siyuewu Khroskyabs.

Transitive	Gloss	Intransitive	Gloss
<i>fɕ^hɬ</i>	cause to melt	<i>dzɬ</i>	melt
<i>fɕ^hɬm</i>	cause to gather	<i>ɛdzɬm</i>	gather
<i>tɕ^háv</i>	cause to trip	<i>dzáv</i>	tumble
<i>ts^hôɣ</i>	attach	<i>dzôɣ</i>	be there (attached)
<i>p^hæɣlɔɣ</i>	cause to lay down	<i>bæɣlɔɣ</i>	be laid down
<i>p^hjæɛ</i>	destroy (financially)	<i>bjæɛ</i>	go bankrupt
<i>p^hráy</i>	tie	<i>bráy</i>	be tied
<i>p^hrê</i>	cause to loosen	<i>brê</i>	become loose
<i>tɕ^hêloy</i>	scatter	<i>dzêloy</i>	be scattered
<i>tɕ^hóv</i>	cause to break	<i>dzóv</i>	break
<i>tɕêrəd</i>	tear	<i>dzêrəd</i>	be torn

Table 3: Anticausative derivation by onset voicing in Siyuewu Khroskyabs

The examples in (1) and (2) illustrate the uses of causative/anticausative pairs in Siyuewu Khroskyabs, with the verb pairs *tɕ^hóv* ‘break (tr)’ / *dzóv* ‘break (intr)’ and *ts^hôɣ* ‘connect’ / *dzôɣ* ‘be connected’.

- (1) a. *ŋæŋjə ts^hædgáv næ-tɕ^həv-n ku-rə rə-ŋó*
 1SG.GEN goat.leg PST-break.II-2SG PST.INV-say.II NPST-be.I
 ‘‘You broke my goat’s leg!’’ He said.’ (syw3708)
- b. *stôd.rjæŋæɕ.ŋæntɕ^ho cə jóɣ=tə næ-dzəv cə gáv=tə*
 INTERJ DEM hand=DEF PST-be.broken.II DEM leg=DEF
næ-níd
 PST-get.hit.II
 ‘Holy India on high! This hand broke, this leg got hit.’ (syw0247)
- (2) a. *æçə ŋəŋjə scí=ræ ku-ts^hûɣ=tə=t^ha roŋsá ɣdə ə-zoŋ*
 CONJ CONJ tripod=one PST.INV-connect.II CONJ water one-bucket
ku-stí rə-ŋó
 PST.INV-put.II NPST-be.I
 ‘Then he set up a tripod, and put a bucket of water on it.’ (syw3729)
- b. *ʃtsə=tə=ɣu kəv=tə næ-dzûɣ=pa rə-ŋó=çəvæ*
 pillar=DEF=LOC needle=DEF PST-be.connected.II=NMLZ NPST-be.I=CONJ
 ‘The needle was stuck on the pillar, and then...’ (syw1877)

Even though Khroskyabs anticausative forms are not prenasalised, [Gates et al. \(forthcoming\)](#) show that prenasalisation existed in an earlier form of Khroskyabs, based on internal evidence as well as evidence from phonetic translations of local place names in Chinese. Moreover, Khroskyabs voiced initials correspond regularly to Japhug prenasalised initials, as illustrated in Table 4.

Khroskyabs	Japhug	Meaning
<i>bád</i>	<i>mbat</i>	be easy
<i>dzíd</i>	<i>ndza</i>	eat
<i>fsædí</i>	<i>fsyndi</i>	the day after tomorrow
<i>ɣdzər</i>	<i>ɣndzur</i>	grind
<i>gí</i>	<i>ŋga</i>	wear

Table 4: Correspondences of voiced initials between Khroskyabs and Japhug

Voiced initials in Khroskyabs found in anticausative derivations are reconstructed with a voiceless initial (aspirated or non-aspirated) preceded by a non-segmental prenasal element that triggered modern voicing. See (3).

- (3) a. $*^n p^{(h)}- > *^n b- > b-$

- b. $*^n t s^{(h)}-$ > $*^n dz-$ > $dz-$
- c. $*^n t^{(h)}-$ > $*^n d-$ > $d-$
- d. $*^n t \zeta^{(h)}-$ > $*^n dz-$ > $dz-$
- e. $*^n c^{(h)}-$ > $*^n \jmath-$ > $\jmath-$
- f. $*^n k^{(h)}-$ > $*^n g-$ > $g-$

Other voiced initials, as long as they have a prenasalised cognate in East-Gyalrongic, are reconstructed with a prenasalised voiced stop, such as $*^n b-$, $*^n dz-$, $*^n d-$, $*^n dz-$ and $*^n g-$.

In a handful of cases, Khroskyabs voiced initials correspond to East-Gyalrongic voiceless initials, as shown in Table 5.

Khroskyabs	Japhug	Cogtse Situ / Others	Meaning
<i>dí</i> (keep)	<i>ta</i>	<i>ka-tá</i>	put
<i>dâγ</i>	<i>taκ</i>	<i>tə-ták</i>	knit
<i>dóγ</i>	<i>tɣ-xtɣγ</i>	<i>tə-ktek</i>	brother
<i>gôγ</i>	<i>kɣγ</i>		bend

Table 5: Khroskyabs voiced initials corresponding to Core Gyalrongic voiceless initials

These forms are reconstructed in the same way as the anticausative voiced initials. Prenasalisation seems to have a variety of different functions, apart from being a detransitiviser in anticausative derivations. In verbal derivations, prenasalisation may be related to the modern autobenefactive/denominal prefix *N-* (Lai 2017: 357-369, 522-524). A detailed description of prenasalisation in Khroskyabs is out of the scope of this paper, and will be presented in a separate study.

- (4) a. $*^n t \text{æ} > d\acute{i}$ ‘keep’
- b. $*^n t \text{æ}^{\vee} k > d\hat{a}\gamma$ ‘knit’
- c. $*^n t \text{ə}^{\vee} k > d\acute{o}\gamma$ ‘brother’
- d. $*^n k \text{o}^{\vee} k > g\hat{o}\gamma$ ‘bend’

3 Detailed analyses of examples of lenition alternations in Khroskyabs

pî ‘year’ ~ *pêvi* ‘this year’

The two words in the first pair, *pî* ‘year’ and *pêvi* ‘this year’, are clearly related. The second syllable of the lenited counterpart *pêvi* ‘this year’ is related to the non-lenited *pî* ‘year’. The first syllable *pê-* finds its non-syllabic variant in *f-snê* ‘today’, in which *snê* is the word for ‘day’. In Cogtse Situ, the cognate is the non-lenited *pîpa* ‘this year’.

= *sipi* ‘NMLZ, material’ ~ *vî* ‘do’

The form = *sipi* ‘NMLZ, material’ is derived from the verb *vî* ‘do’. The *s-* prefix is an ancient nominaliser that derived instruments, its trace can be found in *s-p^hám* ‘lid’, derived from *p^hám* ‘cover’, originally meaning ‘instrument (used to cover something)’. Today, the primary function of = *sipi* is a nominaliser used in irrealis situations, for P-relativisation (Lai 2018) as well as purposive complement structures. See (5).¹

(5) a. P-relativisation

jəmâ nâri = çəvæ vâlkə çî = tə nsyád = spi rə-vê-ŋ
 day tomorrow=CONJ corpse flesh=DEF sell=NMLZ:P NPST-bring.I-1SG
ku-rê rə-ŋóʒ
 PST.INV-say.II NPST-be.I
 ‘Tomorrow, I will bring the flesh of the corpse that is to be sold.’
 (syw0654)

b. Purposive

nû mə-sê-n = spi <bànfá> ŋê st^hú-ŋ = çə
 2SG NEG-die.I-2SG=NMLZ solution 1SG achieve.I-1SG=CONJ
 ‘I have a solution so that you won’t die.’ (syw0044)

¹Examples are glossed according to the Leipzig Glossing Rules (<https://www.eva.mpg.de/lingua/resources/glossing-rules.php>). Other glosses are: CONJ: conjunction and INV: inverse. Verb stems are indicated with roman numerals, I, II and III after a period and the meaning of the verb: ‘be.I’ (Stem I of the verb ‘be’). Chinese loanwords are indicated in South-West Mandarin Pinyin between angled brackets: <bànfá> ‘solution’.

The same derivation can be found in Japhug: *ty-s-pa* ‘material, usage, instrument to do’ is related to *pa* ‘do’.

papâ ‘a kind of tsampa’ ~ *ɣvâ* ‘tsampa’

papâ is a kind of tsampa kneaded into dumpling-like balls, a common way to consume tsampa in Tibetan regions. It is related to the lenited *ɣvâ* ‘tsampa’, referring to all sorts of tsampa in its meal form.

nspâ ‘suppurate’ ~ *svâ* ‘pus’ (Wobzi)

In the Wobzi dialect, the non-lenited *n-spâ* ‘suppurate’ is clearly derived from the lenited *svâ* ‘pus’. The *n-* prefix is denominal in nature, and is still productive, deriving verbs from borrowed nouns: *B<N>lâ* ‘sing’ from *Blâ* ‘song’ (from Tibetan ལྷ་ *glu* ‘song’), *n-revâ* ‘require’ from *revâ* ‘request’ (from Tibetan རེ་བ་ *re.ba* ‘request’), and so on (Lai 2017: 523). In Siyuewu Khroskyabs, the verbal form meaning ‘supperate’ is an innovated form directly derived from the modern nominal *svâd* ‘pus’, yielding *n-svâd* ‘suppurate’.

spâtsæɣ ‘chop’ ~ *rvî* ‘axe’

spâtsæɣ ‘chop’ is an incorporational formation (Jacques 2012b, Lai 2017: 388-413), comprising a nominal part *-pæ-* from *rvî* ‘axe’, a verbal part, *-tsæɣ*, from *tsæɣ* ‘chop’, and a denominal prefix *s-*. The nominal part underwent a bound state process,² changing the original vowel *-i* into *-æ-*, allowing for a reconstruction of a proto **-æ* vowel for both the separate noun and the bound state (Lai forthcoming, see also Table 1 in the supplementary material). The disappearance of the preinitial *r-* in *rvî* ‘axe’ is due to phonotactic reasons (see an explanation in Section 4.4 of the main paper; see also Jacques 2012b: 1228), and will be further discussed below.

stô ‘show’ ~ *vdê* ‘see’

The derivational relation between *s-tô* ‘show’ and *vdê* ‘see’ (*vrô* in Njorogs) is not synchronically transparent. The cognate pair in Japhug, *mtô* ‘see’ vs *su-mtô*

²Bound state is a compound form of nominals involving a rhyme change.

‘show’, indicates that *su-mto* ‘show’ is a causative derivation from *mto* ‘see’, originally meaning ‘make sb. see’. The sibilant causative prefix is quite common in Sino-Tibetan languages (LaPolla 2017: 52), and is productively found in Khroskyabs (Lai 2016). Therefore, the preinitial *s-* in *s-tô* ‘show’ is a causative marker.³ The form *vdê* ‘see’ in Siyuewu Khroskyabs, with a voiced consonant *-d-*, corresponds to the unfortified *-r-* in the Njorogs dialect, with *vrô* ‘see’. The *e*-vocalism is from an earlier **-o* (See Lai forthcoming and Table 1 in the supplementary material).

pætsí ‘piglet’ ~ *zî* ‘son’

The form *pætsí* ‘piglet’ is a fossilised diminutive form of *p^hâγ* ‘pig’. The form *pæ-* is the bound state of *p^hâγ* ‘pig’, and the entire form is to be reconstructed as **pæ[k]tsæ*. The unproductive suffix *-tsí* is related to *zî* ‘son’, which is also the productive diminutive suffix in Siyuewu, for example, in *p^hôsær-zî* ‘young man’ where *p^hôsær* is borrowed from Tibetan རྩོགས་པ་ *pho.gsar* ‘young man’.

stâγ ‘be alone’ ~ *râγ* ‘one’

The forms *râγ* ‘one’ and *s-tâγ* ‘be alone’ share formal similarity and semantic proximity. The *s-* prefix in the non-lenited *s-tâγ* ‘alone’ is a denominal prefix.

skô ‘make an effort’ ~ *γó* ‘be able’

The non-lenited *s-kô* ‘make an effort’ is related to the lenited *γó* ‘be able’. In other West Gyalrongic languages, such as Gexi and Geshiza, only *sko* is attested, taking the meaning ‘be able’. The preinitial *s-* is a causative marker. *skô* ‘make an effort’ is defected and does not have a full-fledged conjugation paradigm like other verbs. It never receives any inflectional prefix, and is almost always suffixed with second person markers. See (6).

- (6) *næ-ldzê-n* *skô-n*
 IMP-learn.I-2PL make.effort.I-2PL
 ‘Study hard!’ (field note)

³The causative *s-* and the denominal *s-* are formally identical and have the same origin (Lai 2017: 526-529, Jacques 2015b).

qî ‘shout (n)’ ~ *s-kî* ‘sound, voice’

The word *qî* ‘shout (n)’ refers to sounds of shouting, and should be reconstructed as **qæ* (Lai forthcoming, Table 1 of the supplementary material). It is comparable to Old Chinese 呼 **q^ha* ‘shout’. This noun can be verbalised with prenasalisation, resulting in **ⁿqæ* > **ⁿGæ* > *gî* ‘shout’.⁴ The form *s-kî* ‘sound, voice’ is related to *qî* ‘shout (n)’, the *s-* prefix is probably an instrumental nominal prefix. Tangut attests a cognate pair, 𐞗𐞙𐞛⁴⁵³³ *qe^{k1}* ‘shout’ vs 𐞗𐞙𐞛¹⁰¹⁰ *ke^{k2}* ‘sound, voice’ (Pre-Tangut **S-qa^k*).

rqê ‘throat’ ~ *r-kæ-lóm* ‘chest’

The *-kæ-* part in the lenited form *r-kæ-lóm* ‘chest’ is related to *rqê* ‘throat’. A similar construction is found in Japhug *rqopa* ‘chest’, which literally means ‘under the throat’, and in Mawo Qiang *ɹu-q^hua* ‘chest’ (Huang and Dai 1992). *r-kæ-lóm* is a compound of three elements. The *r-* part is probably related to the full-fledged Mawo Qiang syllable *ɹu-*, cognate with Mbrongrdzong Khroskyabs *re* ‘chest’, Cogtse Situ *ta-rô* ‘chest, breast’, and Gexi *ro-sto* ‘upper half of the body’.⁵ The middle part *-kæ-* is the bound state of *rqê* ‘throat’, and the last part, *-lóm*, is probably related to *lóm* ‘be wide’. The original meaning *r-kæ-lóm* must have been ‘the region between the throat and the breasts’. A similar meaning is found in the Khang.gsar cognate, *kalə*, meaning ‘the upper quarter of the body’.

rmæstəγ ‘male siblings’ ~ *dóγ* ‘younger brother’

The last two pairs contain each a non-lenited counterpart, and a voiced plosive counterpart. The voiced counterpart should be reconstructed with a prenasalised stop (See Section 2.2 in the supplementary material), hence no lenition is involved. Their cognates in Horpa-Stau are lenited.


The *-təγ* part in *rmæstəγ* ‘male siblings’ is clearly related to *dóγ* ‘younger brother’. The form *rmæstəγ* could be reconstructed as **rmæstuw^(Y)k*, and *dóγ* as **ⁿtə^Yk*. The vocalic alternation between **-ə* and **-u* is also found in verbal ablaut

⁴The voiced uvular stop *G-* does not exist in Khroskyabs. It is therefore plausible to propose that **ⁿq-* became *g-* via **ⁿG-*. See also Section 2.2 in the supplementary material.

⁵The *-sto* part is borrowed from Tibetan 𐍄𐍅 *stod* ‘upper’.

(Lai 2021b). The first part *rmæ-* is related to *rmæ̂* ‘the other person’, cognate of Japhug *tu-rme* ‘human’ and Cogtse Situ *tə-rmî* ‘human’. The *-s-* in the middle is probably related to the Situ *çə-* prefix usually found in terms of mutual kinship relations, such as Bragbar Situ *kə-o-çə-ptêk* ‘male siblings’, *kə-o-çə-mazâ* ‘female cousins whose mothers are sisters’, and *kə-o-çə-mdô* ‘uncle and nephews’, and so on.

stî ‘put’ ~ *dí* ‘keep’

The non-lenited *s-tî* ‘put’ involves a morphological innovation specific to West Gyalrongic languages, compare Khang.gsar *sti* ‘be put’ and Tangut ⁵⁴⁴⁹ *tj¹* ‘put’ (Pre-Tangut **S-ta*). In East Gyalrongic languages, the cognate always appear with a simple onset, as in Japhug *ta* ‘put’ and Cogtse Situ *ka-ta* ‘put’. The *s-* prefix is thought to be a translocative associated motion prefix, cognate of Japhug *çu-* ‘TRANSLOC’ (Lai et al. 2020: 178). The voiced counterpart *dí* ‘keep’ reconstructs as **ⁿtæ*. The prenasal element is probably of autobenefactive origin, related to the modern autobenefactive prefix *N-*. The original meaning of *dí* would thus have been ‘put down for oneself’, hence ‘keep’.

4 Tangut transphonologisation

The Tangut script is largely non-phonetic and its phonology is reconstructed from indirect sources. In this paper, Gong Xun’s (Gong 2017, 2020) reconstruction, a modified version of Gong Hwang Cherng’s Tangut Phonology, is employed.

Compared to modern Gyalrongic with complex onset systems, Tangut’s system is simplified. Some Pre-Tangut preinitials may have simply dropped, while some are still traceable on the rhymes, resulting in a phenomenon referred to as transphonologisation.

Transphonologisation in Tangut can be summarised according to the Pre-Tangut reconstruction of Jacques (2014) and Gong (2020):

1. A preinitial **S-*, which may represented the likes of **s-*, **ç-* and **l-*. transphonologised into a tense vowel.

2. In some cases, a preinitial **r-* contributed to the retroflexion of Tangut vowels.
3. A preinitial **p-* transphonologises into a medial *-w-*.
4. A velar or a uvular element, be it a coda, a preinitial, or a presyllable, is the source of vowel uvularisation in Tangut.
5. A **C-* is systematically reconstructed for lenited initials.

Table 6 shows Tangut examples that underwent transphonologisation, compared with their Khroskyabs and Japhug cognates, and accompanied by the corresponding Pre-Tangut forms reconstructed following the logic of Jacques (2014).







Khroskyabs	Japhug	Tangut	Pre-Tangut	Meaning
<i>lbé</i>	<i>tx-rmbi</i>	 ⁵⁵⁰⁹ <i>bi</i> ¹	<i>*S-bi</i>	urine
<i>χspî</i>	<i>qaçpa</i>	 ⁰⁴⁹⁹ <i>pʃe</i> ^{κ1}	<i>*S-pʃa</i> ^κ	frog
<i>rtsô</i>	<i>qartsu</i>	 ¹⁴⁶⁴ <i>tsu</i> ^{κr1}	<i>*r-tsu</i> ^κ	winter
<i>rŋê</i>	<i>arŋi</i>	 ⁰⁶⁵⁴ <i>ŋwə</i> ^{(κ)r2}	<i>*r-ŋwə</i> ^(κ)	be blue
<i>fsê</i>	<i>fse</i>	 ¹⁶⁷⁰ <i>swij</i> ¹	<i>*p-sij</i>	sharpen
<i>ftç^hê</i>	<i>ftçi</i>	 ³⁹²⁹ <i>tç^hwi</i> ¹	<i>*p-tç^hi</i>	melt (vt)

Table 6: Tangut transphonologisation compared to Khroskyabs and Japhug

5 Inflectional and derivational prefixes in East and West-Gyalrongic

Verbal inflectional prefixes in Khroskyabs, as well as in other West-Gyalrongic languages, are in most cases syllabic, and derivational prefixes are non-syllabic. In East-Gyalrongic languages, both types of prefixes are syllabic.

Table 7 (inflectional⁶) and Table 8 (derivational) show prefix comparisons between West and East-Gyalrongic languages.

⁶This table shows orientation prefixes in Gyalrongic languages. Orientation prefixes are, apart from indicating directions, the main device for properties of tense-aspect-modality-evidentiality in Gyalrongic languages. East-Gyalrongic forms that are not cognates with Khroskyabs are shaded.

Khroskyabs	Japhug	Bragbar Situ	Cogtse Situ
<i>o-</i> ‘up’	<i>tɣ</i> ‘up’	<i>rɐ-</i> ‘up’	<i>to-</i> ‘up’
<i>næ-</i> ‘down’	<i>pu-</i> ‘down’	<i>na-</i> ‘down’	<i>na-</i> ‘up’
<i>læ-</i> ‘upstream’	<i>lɣ-</i> ‘upstream’	<i>rɐ-</i> (no gloss)	<i>ro-</i> ‘upstream’
<i>və-</i> ‘downstream’	<i>tʰu-</i> ‘downstream’		<i>rə-</i> ‘downstream’
<i>kə-</i> ‘dark side’	<i>kɣ</i> ‘east’	<i>wo-</i> ‘upstream’	<i>ko-</i> ‘upstream’
<i>nə-</i> ‘sunny side’	<i>nu-</i> ‘east’	<i>nə-</i> ‘downstream’	<i>nə-</i> ‘west’

Table 7: Orientation prefixes in Gyalrongic

Khroskyabs	Japhug	Bragbar Situ
<i>ɛ-</i> ‘INTR’	<i>a-</i> ‘INTR’	<i>o-</i> ‘INTR’
<i>N-</i> ‘AUTOBEN’	<i>nu-</i> ‘INTR’	<i>nə-</i> ‘AUTOBEN’
<i>v-</i> ‘CAUS’	<i>su-</i> ‘CAUS’	<i>sə-</i> ‘CAUS’
<i>s-</i> ‘CAUS’	<i>yu-</i> ‘CAUS’	<i>va-</i> ‘CAUS’

Table 8: Derivation prefixes in Gyalrongic

Inflectional prefixes are reconstructed with a neutral vowel **Cə-*, and derivational prefixes with a shortened vowel **Cǎ-*. The contrast is preserved in West-Gyalrongic, reflected in the syllabicity, while it is neutralised in East-Gyalrongic as both types are equally syllabic.

6 Lenition discrepancies between Khroskyabs and other WG languages

While many etyma with lenition are shared among West-Gyalrongic languages, yet there are also several pairs that are uniquely found in some languages. Moreover, the leniting conditions between Khroskyabs and other West-Gyalrongic languages seem to be slightly different, for instance, only unaspirated initials participated in lenition in Khroskyabs, and some aspirated initials are also lenited in Horpa-Stau. With our current knowledge, it is still difficult to reveal the whole picture of Horpa-Stau lenition, even though a good part of it has been explained through lenition alternation in this paper.

Table 9 shows lenition discrepancies between Khroskyabs and other West-Gyalrongic languages. The first part of the table shows lenited examples in Khroskyabs corresponding to non-lenited ones in Geshiza, Khang.gsar and Tangut, and vice-versa in the second part.

Khroskyabs	Geshiza	Khang.gsar	Tangut	Meaning
<i>dyú</i>	<i>ko</i>	<i>fkú</i>	𐵇 ³³⁰⁵ <i>kiw¹</i>	year, age
<i>vyí</i>	<i>vk^hə</i>	<i>fkə</i>	𐵇 ³⁸⁶⁹ <i>kwí¹</i>	be satiated
<i>svíy</i>	<i>spa</i>	<i>spar</i>	𐵇 ⁴⁵³² <i>pā^{κ2}</i>	be thirsty
<i>svêd</i>	<i>spa</i>	<i>spə</i>	𐵇 ⁵²⁷⁴ <i>pə^{κ1}</i>	pus
<i>p^hây</i>	<i>va</i>	<i>va</i>	𐵇 ⁰²⁹⁴ <i>.wa^{κ1}</i>	pig
<i>rp^hám</i>	<i>lvo</i>	<i>rvə</i>	𐵇 ⁴⁰⁵³ <i>.wə^{κ1}</i>	ice
<i>ɬp^héɛ</i>	<i>lbala</i>	<i>rbala</i>	𐵇 ⁴⁵⁶⁷ <i>bā^{κ2}</i>	leaf
<i>p^héz</i>		<i>p^hɛ</i>	𐵇 ⁴⁵⁸⁵ <i>.wa¹</i>	vomit

Table 9: Lenition discrepancies between Khroskyabs and other WG languages

In the cognate set for ‘year, age’, the lenited Khroskyabs form *dyú* reconstructs back to **-tə-k[u]*. The Khang.gsar form *fkú* is with a consonant cluster which blocks lenition. The Geshiza form *ko* is problematic. Khroskyabs and Khang.gsar *-u* regularly corresponds to Geshiza *-uə*: Khroskyabs *rq^hú* ‘shell’ vs Geshiza *rq^huə* ‘shell’, Khang.gsar *xɬu* ‘testicles’ vs Geshiza *lguə*. The *o*-vocalism in Geshiza *ko* ‘year, age’ is irregular, and it is not impossible that it is due to a medial that merged with the original vowel, which also blocks lenition, as in Gexi *kvo* ‘year’. The Tangut form is also likely to be irregular, Jacques (2014: 191) interprets the final *-w* as the reflex of Pre-Tangut **-k*, which may correspond the coda in Njorogs *dyuk* ‘year’, although the Njorogs coda seems secondary to me and should be explained otherwise. In any case, the non-lenition in Horpa-Stau/Tangut is likely to be due to a consonant cluster that did not exist in Khroskyabs.

Tangut 𐵇³⁸⁶⁹ *kwí¹* ‘to be satiated’ is interesting in that it has a tense vowel that originated from a preinitial. One could postulate a Pre-Tangut form *#’Sə-pǎ.ka*, instead of Jacques’ 2014 **S-pk(j)a*, that underwent intersyllabic compression, as in (7).

- (7) #*Sǎ-pǎ.ka* > #*Sǎ-p.ka* (intersyllabic compression) > #*S-p.ka* > *kwǐ* ‘be satiated’

The #*Sǎ-* prefix could be a deexperiencer prefix, related to the deexperiencer prefix *sɣ-* in Japhug (p.c. XXX, 14 November, 2020), making the verb mean ‘be liable to cause somebody to be satiated’ (Jacques 2012a: 216). This affixation could be responsible for the aspiration in Geshiza *fk^hə* ‘be satiated’, but left no trace in Khang.gsar.

The last two cognate sets in the first part of the table are both with an *s-* preinitial. They are invariably non-lenited in Horpa Stau/Tangut, while lenited in Khroskyabs. **sǎ.pik* (> *svíγ*) ‘be thirsty’ and **sǎ.puut* (> *svêd*) ‘pus’ are reconstructed for Khroskyabs, while only #*s-* can be reconstructed for the rest of the languages, as there is no reliable sign for a compression. The preinitial *s-* here are of unknown function, and could possibly be merely an unseparable part of the stem. It is possible that the common ancestor of Horpa-Stau and Tangut simplified the Proto-presyllable into a preinitial, while Khroskyabs merged it with other **sǎ-*presyllables.

The second part of the table involves non-lenited examples in Khroskyabs, and lenited examples in other languages. It can be easily observed that all the examples in Khroskyabs are aspirated, which points to a possible Khroskyabs innovation, especially for the first three examples, ‘pig’, ‘ice’ and ‘leaf’. The last example, ‘vomit’, is non-lenited and aspirated in Khang.gsar, while lenited in Tangut. The cognate in Japhug is *muǰp^hɣt* ‘vomit’, indicating an original aspirated initial. The Pre-Tangut form is to be reconstructed as #*Cǎ-p^(h)aC*, the presyllable #*Cǎ-* could correspond to *mu-* in Japhug, similar to the case of ‘smoke (n)’ presented in Section 5.2 of the main article. The forms for ‘smoke’ in modern West Gyalrongic coming from the compound of ‘fire’ and ‘smoke’ are originally proposed by Jacques et al. (2017: 610). The case of Tangut is probably first proposed in a blog post by Mathieu Beaudouin (Beaudouin 2020), which should have been cited in the main article, although not published officially. I am citing the blog post here for the completeness of bibliography.

Table 10 shows the lenition alternation gaps attested across West-Gyalrongic languages. The rows shaded in light grey also appeared in Table 9 in the main

article. The dark grey cells are definitive gaps, with confirmed absence of a lenition counterpart. The cells with a question mark are unconfirmed gaps, meaning the lenition counterpart are merely unattested and could be found out as our knowledge increases.

Language	Non-lenited	Meaning	Lenited	Meaning
Geshiza	<i>-sq^ha</i>	ten (suffix)	<i>zɣæ</i>	ten
Khroskyabs			<i>sjəd</i>	ten
Tangut			<i>ᠰᠠᠵᠠ^{k2}</i>	ten
Geshiza	<i>rmæsti</i>	male siblings	<i>ri</i>	brother
Gexi	<i>rmæsti</i>	male siblings	?	?
Gexi	<i>sti</i>	existential verb	<i>nə-ri</i>	put in
Geshiza	<i>sti</i>	put in	?	?
Khang.gsar	<i>st^hə</i>	existential verb	?	?
Tangut	<i>ᠰᠢᠲᠢ⁵⁴⁴⁰ tᶦ¹</i>	put in	?	?
Khroskyabs	<i>stî</i>	put in	?	?
Gexi	<i>spə</i>	down	<i>və</i>	bottom
Geshiza	?	?	<i>və</i>	down, below
Tangut	?	?	<i>ᠰᠢᠪᠠᠨ⁰⁹⁰⁰ wi²</i>	bottom
Khroskyabs	?	?	<i>ví</i>	bottom
Khang.gsar	<i>ŋq^hi</i>	become thin	<i>rɕəbə</i>	thin person
Geshiza	<i>ŋq^hi</i>	be thin	?	?
Tangut	?	?	<i>ᠰᠢᠪᠠᠨ¹⁶⁸⁰ ᠪᠢᠶᠠᠵᠠᠵᠠᠰᠤ^{k2}</i>	be thin
Khang.gsar	<i>qəsjɪ</i>	tomorrow	<i>zɕəvə</i>	in two years
Geshiza	?	?	<i>zɣæde</i>	in three days
Tangut	?	?	<i>ᠰᠢᠪᠠᠨ^{k2} dij¹</i>	in three days
Khroskyabs	?	?	<i>zɕədí</i>	in three days
Khroskyabs	<i>qî/gî or gîja</i>	shout (n)/shout (v)	<i>sɕí</i>	sound, voice
Khang.gsar	<i>qəjev</i>	shout (v)	?	?
Tangut	<i>ᠰᠢᠰᠢᠶᠢᠨ⁴⁷³⁹ tsew^{k1}</i>	joint	<i>ᠰᠢᠵᠢᠨ⁴²⁰⁹ zew^{k2}</i>	joint, wrist
Gexi	<i>sts^ho</i>	wrist	?	?
Khroskyabs	<i>rts^hôy</i>	level	?	?
Tangut	<i>ᠰᠢᠰᠢᠶᠢᠨ⁴³²³ kur¹</i>	fumigate	<i>ᠰᠢᠵᠢᠨ³⁶⁷³ yu¹</i>	smoke (n)
Geshiza, etc.	<i>mk^hə</i>	smoke (n)	?	?
Khroskyabs	<i>mk^həd</i> (n)	smoke (n)	?	?
Tangut	?	?	<i>ᠰᠢᠵᠢᠨ²⁸⁸³ gwîr¹</i>	window
Geshiza	<i>kærku</i>	window	?	?

Table 10: Lenition alternation gaps among West-Gyalrongic languages

7 Accounting for exceptions

I have proposed several origins for presyllables that disappeared in the modern language in the main article.

1. (A) verbal inflectional prefix(es) **Cə-*
2. An inalienable possessive prefix **[t]ə-*
3. A numeral prefix **kə-* for *rəy* ‘one’ (< **kə-tæk*)

The numeral prefix **kə-* could well have been preserved in *stây* ‘be alone’ (< **'sə-kə-tæk*) as velarisation. Body parts and kinship terms are lenited as expected without exception, indicated with the reconstruction of **[t]ə-*. However, several verbs with non-lenited simplex onsets are found,⁷ listed in Table 11.

Khroskyabs	Japhug	Bragbar Situ	Other WG languages	Meaning
<i>tô</i>			<i>tje</i> (Geshiza)	appear, come
<i>pễm</i>	<i>jpum</i>	<i>jpễm</i>	𐵇𐵏 ¹⁸⁰⁵ .wɔ̃ ^{ɛ1} (Tangut)	be thick (diameter)
<i>tsây</i>		<i>rantsík</i>	<i>tsu</i> (Khang.gsar)	chop, cut
<i>tsễm</i>	<i>xts^hum</i>	<i>tç^him</i>	<i>xts^ho</i> (Gexi)	be thin (diameter)
<i>tól</i>			<i>ltə</i> (Geshiza)	hit
<i>tễv</i>	<i>arturtɣβ</i>			twine
<i>qễɕ</i>	<i>nɣrqəɕ</i>		𐵇𐵏 ⁵³¹³ qə̃ ^{ɛ1} (Tangut)	pull up
<i>qô</i>				be dense and sticky
<i>pôz</i>				be luxuriant

Table 11: Non-lenited verbs in Khroskyabs with their cognates

The verb form *tô* actually represent two synchronically separate verbs, the orientation-unmarked (O-U) *tô* ‘appear’, and the orientation-explicit (O-E) (*rə*)-*tô* ‘come’. The O-U *tô* ‘appear’ is not lexically assigned an orientation prefix to indicate past tense. See (8) (with its Stem 2 form *t^hód*).

⁷I have excluded compound verbs, which are also few in number, that could be considered exceptions. Compound verbs may have undergone further morphological operations or emerged after lenition ceased to be productive.

- (8) *æ̂çə r̄kǽlóm f̄qr̄áç dz̄ôm t^hód*
 CONJ chest pattern IDEO:beautiful appear.II
 ‘Then, beautifully, some patterns appeared on the chest.’ (syw0536)

The O-E (*rə*)-*tô* ‘come’, on the contrary, is always accompanied by an orientation prefix. See (9).

- (9) *æ̂çəv̄æ n̄æ-l̄kó xt̄çôp^hə = t̄ə = r̄ə ɣd̄ə = k^he n̄æ-t^hód r̄ə-ŋó*
 CONJ IPFV-be.pitiable.II leper=DEF=TOP water=DAT PST-come.II NPST-be.I
 ‘Then the poor leper came by the water.’ (syw0784)

The O-U *tô* ‘appear’ is the source of the O-E (*rə*)-*tô* ‘come’ by Lai (2021a). I mentioned in Section 3.4 in the main article that Khroskyabs verbs are usually prefixed with an inflectional prefix. The original O-U *tô* ‘appear’ does not select any inflectional prefix, which means it appears as a bare stem most of the time, therefore, it is not strange that it was not affected by lenition.

The examples in the middle part of Table 11 have cognates in other Gyalrongic languages with a preinitial. The preinitials are in most cases *r(V)*-, but *l*- (East Gyalrongic *j*- comes from **l*-, see Jacques 2004: 271) and *x*- are also attested.

The verb *tól* ‘hit’ is of particular interest. It corresponds to Geshiza *l̄ə* ‘hit’, which points to a possible metathesis in Khroskyabs. The mechanism of this metathesis is not yet clear, however, other types of metatheses are also found in Khroskyabs dialects, such as Wobzi (Lai 2016).⁸

The only valid exceptions are the last two examples in Table 11, *qô* ‘be dense, sticky’ and *pôz* ‘be luxuriant’. However, no cognates are found in other Gyalrongic languages, not even in the West Gyalrongic branch. This implies that these two words are probably Khroskyabs (or even Siyewu) innovations. Their specific semantics hints that they could also be of ideophonic origin, which commonly exhibit phonological peculiarities (Dingemans 2012: 655). In Japhug, for example, there are 17 consonant clusters that are only attested in ideophones, such as *bj*- in *bjuy* ‘soft and hanging’, and *cl*- in *cləŋ* ‘round and well-polished’ (Jacques 2013: 265).

A final minor issue is the problem concerning *stí* ‘put’ (~ *dí* ‘keep’). This form can only be reconstructed as **s-tæ*, and there is no evidence for the prefix **s*-

⁸All the other counter-examples in this category are closed syllables, it is possible that the preinitial dropped after being metathesised because of the prohibition of certain complex finals.

here is compressed from a certain *sǝ-. As is explained in Section 3, the prefix *s- is neither a causative nor a denominal, it is probably a marker for translocative associated motion, which does not necessarily need to be reconstructed with a presyllable.

8 Computational implementation of the proposed model

The Python script *lenition.py* is a compilation of all the sound changes proposed in the main article. The code is capable of accounting for all the examples of lenition alternation in Khroskyabs. Every stage of sound change is output automatically for every single example. The successful implementation of the proposed sound laws implies the their high plausibility.

The code can be run with the following command (it works with the file *protoforms.txt*):

```
$ python3 lenition.py
```

8.1 lenition.py

```
import pandas as pd
import os

cons = ["p", " ", " ", "t", "k", "q"]
soft = ["v", "z", " ", "r", " ", " "]
softcd = ["v", "d", " ", " "]
pcon = ["r", "l", "s", "p", "k", "q"]

ptf = open("protoforms.txt", "rt")
ptf2 = open("predf.txt", "a")
ptf2.write('Pre1,Pre2,Stem'+'\n')
ptf2.close()
ptf3 = open("predf.txt", "a")
for line in ptf:
    ptf3.write(line.replace('-', ', '))
```

```

ptf.close()
ptf3.close()

predf = pd.read_csv('predf.txt')
prb = predf['Pre1'].values
prblist = prb.tolist()
pra = predf['Pre2'].values
pralist = pra.tolist()
syl = predf['Stem'].values
syllist = syl.tolist()

for n, i in enumerate(prblist):
    if i == "$\varnothing$":
        prblist[n] = ''

for n, i in enumerate(pralist):
    if i == "$\varnothing$":
        pralist[n] = ''

os.remove("predf.txt")

result = open("result.txt", "a")

i=0
while i < len(prblist):

    xpreb = prblist[i]
    xprea = pralist[i]
    syl = syllist[i]
    result.write("Proto-form: "+xpreb+xprea+syl+"\n")

    csyl = syl[0]

```

```

fsyl = syl[1:]

if xpreb:
    if xpreb[0] == " ":
        xprea = xprea[0]
        result.write("Intersyllabic compression: "+xpreb+xprea+syl+"\n")
        # xcprea = xprea[0]
        # xfprea = xprea[1:]
    else:
        xprea = xprea

if len(xprea) > 0:
    xcprea = xprea[0]
    xfprea = xprea[1:]

try:
    if not xprea:
        xmod = syl
        result.write("No lenition: "+xmod+"\n")

    if not xfprea or xfprea[-1] == "C":
        xmod = xprea+syl
        result.write("No lenition: "+xpreb+xmod+"\n")

    if xpreb != "CV":
        xmod = xpreb[-3]+xmod
        result.write("Presyllable reduction: "+xmod+"\n")

    if xpreb[-3]+xprea+csyl in ["skt", "spt", "srp"]:
        xmodo = xpreb[-3]+syl+"^"+xprea
        result.write("Transphonologisation: "+xmodo+"\n")

        if xmodo == "stæk^k":

```

```

        xmodo = "st^ "
        result.write("Develarisation: "+xmodo+"\n")

    if xmodo == "sto^p":
        xmodo= "stô"
        result.write("Develarisation: "+xmodo+"\n")

    if xmodo == "spæ^r":
        xmodo = "spæ(tsæ)"
        result.write("Derhoticisation: "+xmodo+"\n")

except:
    pass

try:
    if xfprea and xfprea[-1] != "C":
        xcm0d = soft[cons.index(csyl)]
        xstga = xprea+xcm0d+fsyl
        xmod = xstga
        result.write("Lenition: "+xstga+"\n")

    if xprea == "kə" or xprea == "Cə":
        xmod = xcm0d+fsyl
        result.write("Presyllable deletion: "+xmod+"\n")

    elif xcprea in pcon and xcprea != csyl:
        xstgb = xcprea+xcm0d+fsyl
        xmod =xstgb
        result.write("Presyllable reduction: "+xstgb+"\n")

    if xcprea == "p":
        xmod = "v"+xcm0d+fsyl
        result.write("Assimilation: "+xmod+"\n")

```

```

        if xcm0d == "r":
            xmod = "v"+"d"+fsyl
            result.write("Refortition: "+xmod+"\n")

    if xcprea == "k":
        xmod = " "+xcm0d+fsyl
        result.write("Assimilation: "+xmod+"\n")

    if xcprea == "q":
        xmod = " " + xcm0d+fsyl
        result.write("Assimilation: "+xmod+"\n")

    elif xcprea == "t":
        if xcm0d == " ":
            xmod = xcprea+xcm0d+fsyl
            result.write("Preservation of t- before -: "+xstgb+"\n")

            if xmod == "t u":
                xmod = "d u"
                result.write("Voicing of classifier: "+xmod+"\n")

        else:
            xmod = xcm0d+fsyl
            result.write("Presyllable deletion: "+xmod+"\n")

except:
    pass

if xmod == "pæ":
    xmod = "pî"
    result.write("Vowel change: "+xmod+"\n"+"n")

```

```

if xmod == "pǝvǽ":
    xmod = "pêvi"
    result.write("Vowel change: "+xmod+"\n"+"")

if xmod[:3] == "spǽ":
    xmod = " CV=spi"
    result.write("Vowel change: "+xmod+"\n"+"")

if xmod == "pǽ ":
    xmod = "p "
    result.write("Develarisation: "+xmod+"\n")

    result.write("Reduplication: "+"p p̂"+"n"+"")

if xmod == " vǽ ":
    xmod = " v̂"
    result.write("Develarisation: "+xmod+"\n"+"")

if xmod == "nsp t":
    xmod = "nspê"
    result.write("Modern Wobzi form: "+xmod+"\n"+"")

if xmod == "sv t":
    xmod = "svêd"
    result.write("Vowel change: "+xmod+"\n"+"")

if xmod == "rvǽ":
    xmod = "rvî"
    result.write("Vowel change: "+xmod+"\n"+"")

if xmod == "vdo":
    xmod = "vdê"
    result.write("Vowel change: "+xmod+"\n"+"")

```

```

if xmod == "pæC æ":
    xmod = "pæ æ"
    result.write("Simplification of middle cluster: "+xmod+"\n")

    xmod = "pæ i"
    result.write("Vowel change: "+xmod+"\n"+"")

if xmod == "zæ":
    xmod = "zî"
    result.write("Vowel change: "+xmod+"\n"+"")

if xmod == "ræk":
    xmod = "rê "
    result.write("Coda change: "+xmod+"\n"+"")

if xmod[:4] == "sko ":
    xmod = " CV=sko"
    result.write("Develarisation: "+xmod+"\n"+"")

if xmod == " o ":
    xmod = " o"
    result.write("Develarisation: "+xmod+"\n"+"")

if xmod == "qæ":
    xmod = "qî"
    result.write("Vowel change: "+xmod+"\n"+"")

if xmod == "s æ":
    xmod = "s î"
    result.write("Vowel change: "+xmod+"\n"+"")

if xmod == "rqo":

```



```

xmod = "rqe"
result.write("Vowel change: "+xmod+"\n"+"")

if xmod == "r o":
    xmod = "r æ(lôm)"
    result.write("Construct state: "+xmod+"\n"+"")

i=i+1
for name in dir():
    if name.startswith('x'):
        del globals()[name]

result.close()

```

8.2 protoforms.txt

Ø-Ø-pæ
 Ø-pǎ-pæ
 CV-sǎ-pæ
 Ø-Cǎ-pæ
 Ø-Ø-pæ^y
 Ø-kǎ-pæ^y
 'nǎ-sǎ-p t
 Ø-sǎ-puut
 'sǎ-rǎ-pæ
 Ø-rǎ-pæ
 'sǎ-pǎ-to
 Ø-pǎ-to
 Ø-pæC-tsæ
 Ø-tǎ-tsæ
 'sǎ-kǎ-tæk
 Ø-kǎ-tæk
 'CV-sǎ-ko^y

∅-Cə-ko^y

∅-∅-qæ

∅-sǎ̃-qæ

∅-r-qo

∅-rǎ̃-qo

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