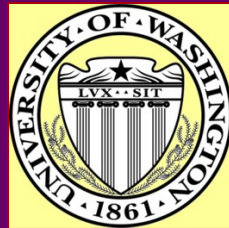


Vowel quality and duration in Deg Xinag

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Deg Xinag language

- Athabaskan family
- Spoken in western Alaska
- Moribund; 7 speakers left

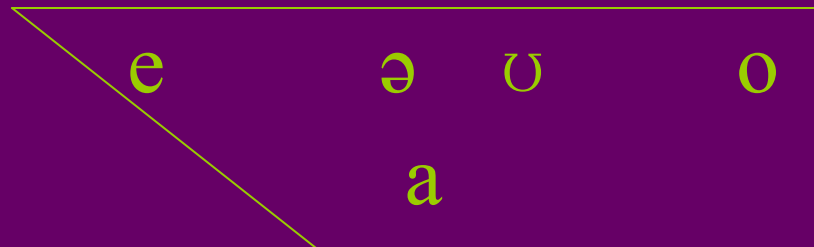
Deg Xinag, a.k.a.
Deg Hit'an



Map based on Krauss, Michael (1974) "Native Peoples and Languages of Alaska". Fairbanks: Alaska Native Language Center, UAF

Vowel inventory

- Krauss 1962



- Unusual absence of high vowel phonemes
 - What about [ʊ]?
 - auditory impression: [õ]
 - restricted in distribution, only occurs adjacent to uvulars

Krauss, Michael (1962) “Ingalik.” Alaska Native Language Center, UAF, Ms.

Consonant places of articulation in DX

- Labial (fricative, nasals)
- Interdental (affricates, fricatives)
- Alveolar (oral and nasal stops, sibilant affricates and fricatives, lateral affricates and fricatives)
- Retroflex (sibilant affricates and fricatives)
- Palato-alveolar (affricates, fricative)
- Palatal (glides)
- Velar (oral, nasal stops)
- Uvular (stops, fricatives)
- Glottal (stop, fricative)

Research questions

- (preliminary to a study of vowel overlap in 3 dimensions, cf. Morrison 2007)
- What are the spectral properties of the Deg Xinag vowels?
 - What are effects of retroflexion, uvular place?
- Which vowels are significantly different in duration?

Morrison, Geoffrey Stewart (2007) Comment on “A geometric representation of spectral and temporal vowel features: Quantification of vowel overlap in three linguistic varieties”... *JASA* 123: 37-40.

Method

Participants

- 8 adult native speakers (3 male, 5 female)
- Ages
 - apx. 68-76 at time of recording
 - 3 speakers now deceased
- All bilingual in English
 - varying oral proficiency
 - minimal written proficiency for all but 3 speakers

Recordings

- Recording equipment
 - professional CD recorder or compact flash recorder
 - AT 4041 microphone
- Sampling rate
 - recorded at 44,100 Hz
 - downsampled to 11,025 for analysis
- Four repetitions; sets of repetitions recorded in random order
- Vowel duration word list
 - Sentence context, presented in local orthography
 - **chenh** _____ **didaghsne**’ “I said _____ again”
again I said
 - Two consonantal contexts
 - vls. unasp. **alveolar** stop ____ vls. unasp. **alveolar** stop or affricate
 - vls. unasp. **uvular** stop ____ vls. unasp. **alveolar** stop or affricate

- Vowel quality word list
 - Words recorded in isolation
 - except for some words taken from vowel duration word list
 - Five consonantal contexts
 1. Alveolar ___ alveolar
 2. Alveolar ___ retroflex
 3. Retroflex ___ alveolar
 4. Uvular ___ alveolar
 5. Alveolar ___ uvular
 - Justification for retroflex: Proto-Athabaskan vowels > centralized monophthongs or diphthongs in Upper Tanana before retroflex consonants (Tuttle and Lovick 2008)
 - Justification for uvular: /ʊ/ only occurs adjacent to a uvular consonant in DX

Tuttle, Siri and Olga Lovick (2008) “The development of the Upper Tanana vowel system.” Poster presented at Annual Meeting of SSILA, Chicago.

Acoustic analysis

- Vowel quality
 - Praat (version 4.3.27)
 - Lowest four formants measured at steady-state
 - Maximum Formant settings
 - 5000 Hz for men
 - 5500 Hz for women
- Vowel duration
 - Multi-Speech 2.5
 - Duration measured between tags at onset and offset of F2

Statistical analysis

- Repeated measures ANOVA
 - Vowel duration studies
 - Independent variable: Vowel
 - Dependent variable: each speaker's mean vowel duration
 - Vowel quality studies
 - Independent variable: Vowel
 - Dependent variable: each speaker's mean log-normalized F1 and F2 (Nearey 1978, 1989)
- Post hoc analysis: Bonferroni/Dunn
- Alpha level: .05

Nearey, Terrance M. (1978) *Phonetic feature systems for vowels*. Bloomington: IULC.

Nearey, Terrance M. (1989) "Static, dynamic and relational properties in vowel perception." *JASA* 85:2088-2113.

Results

Spectral properties of vowels

- Sample vowel plots on following slides generated with PlotFormants
 - F2 (horizontal axis) x F1 (vertical axis) (Bark scale)
 - Large symbols plotted at means
 - Ovals show 2 standard deviations
 - Same speaker, HM (female)
- Repeated measures ANOVA results

- Alveolar ___ alveolar
 - Note relatively low F1 and high F2 for /ə/ ([ɪ]-like)



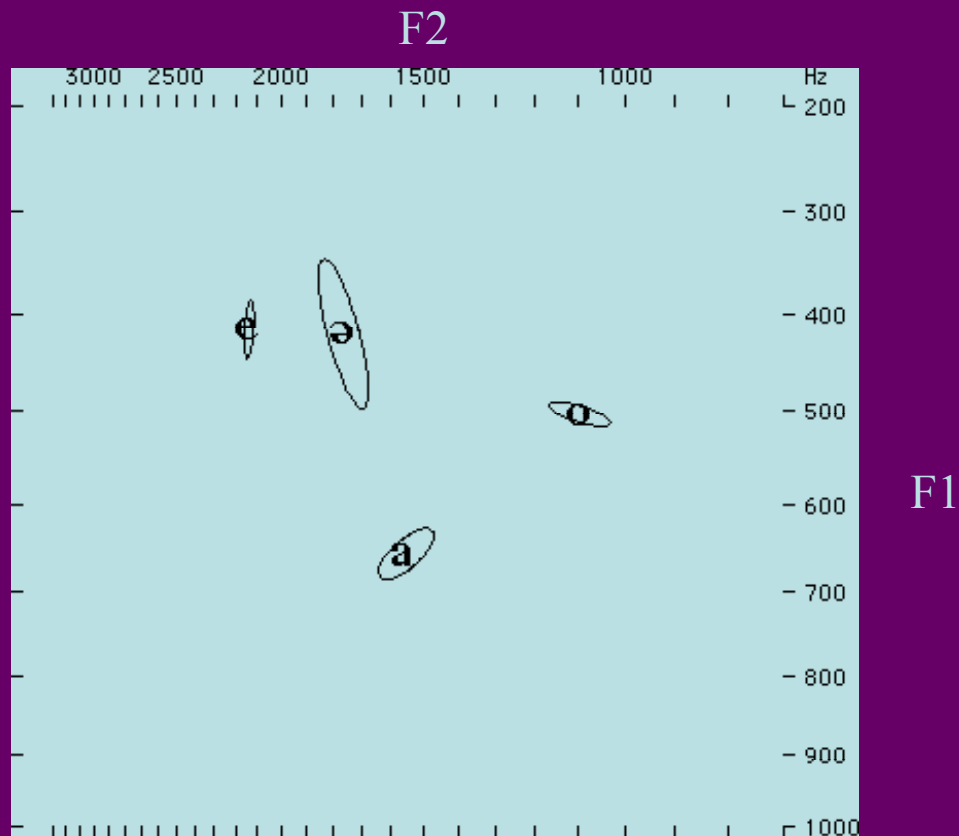
- Post hoc results
 - Normalized F1
 - All vowel pairs significantly different except /e o/
 - Normalized F2
 - All vowel pairs significantly different except /e ə/

Speaker HM

- 🔊 [ntataʔ] ‘when (in the future)?’
- 🔊 [ʔeGətəd] ‘eel’
- 🔊 [taʔtədd̥] ‘red-necked grebe’
- 🔊 [ŋətət] ‘downriver (at place)’

- Retroflex alveolar

- Note absence of fronting and raising of /ə/ in this context



- Post hoc results

- Normalized F1

- All vowel pairs significantly different except /e o/, /e ə/, /ə o/

- Normalized F2

- All vowel pairs significantly different

Speaker HM



[tʂ^haɪtθ'et] 'kashim'



[tʂed] 'seldom'

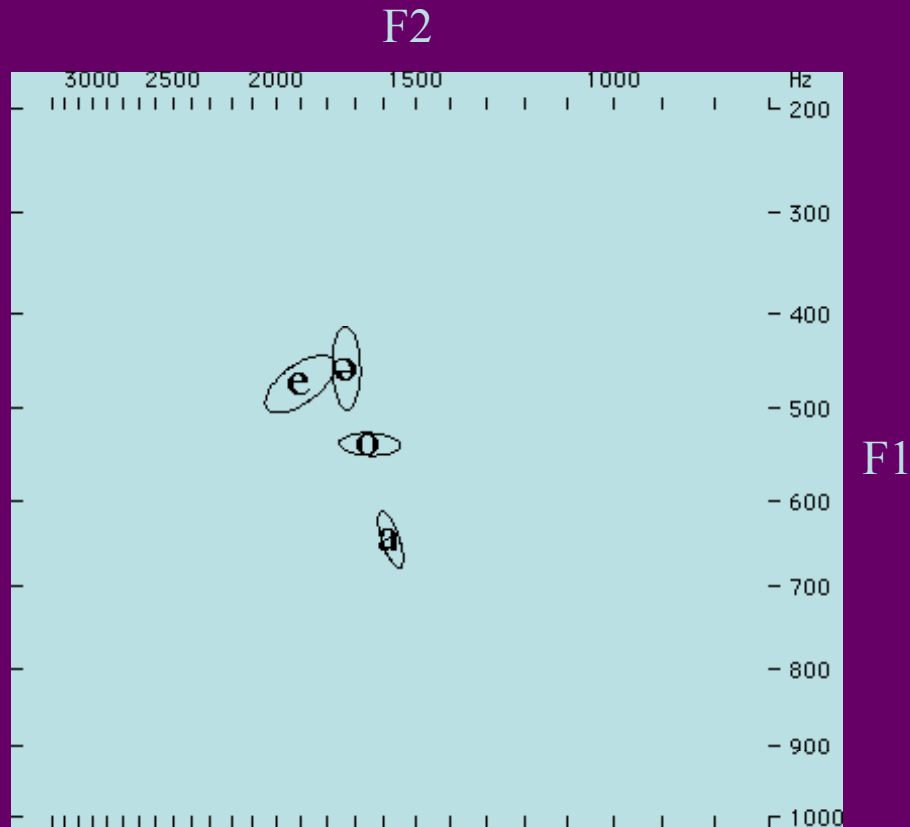


[χaθtʂot] 'they're lying down'



[vətʂod] 'his shin'

- Alveolar retroflex
 - Note centralization of all vowels



- Post hoc results
- Normalized F1
 - All vowel pairs significantly different except /e o/, /e ə/, /ə o/
- Normalized F2
 - All vowel pairs significantly different except /a o/, /e ə/

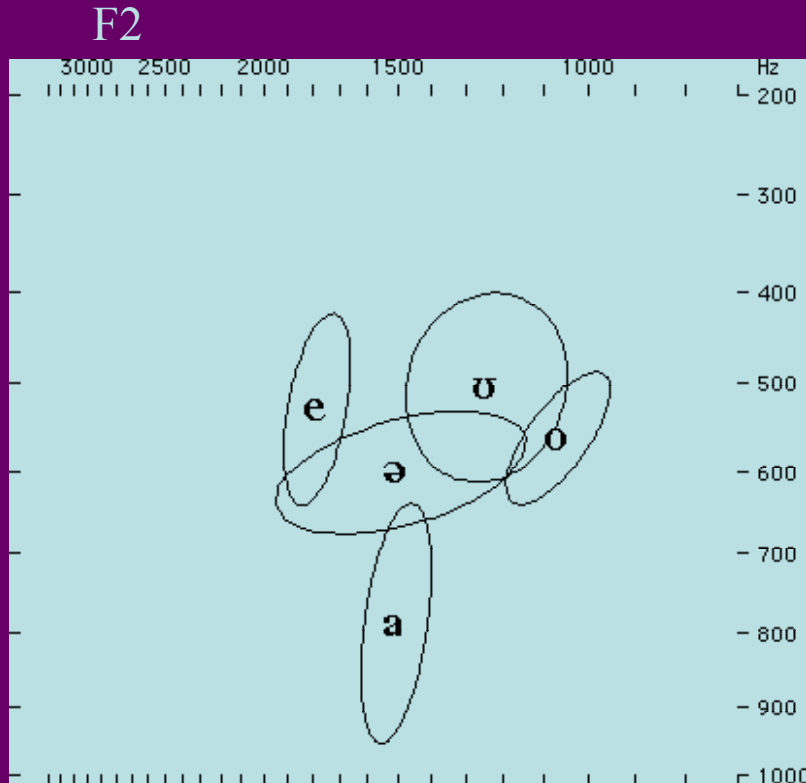
Speaker HM



- [vətadz] ‘his younger sister’
- [t̪etʂ’aʔ] ‘female dog’
- [ðət̪otʂ] ‘he urinated’
- [vəjotʂ’aʔ] ‘his daughter-in-law’

- Uvular ___ alveolar

- Note more compressed vowel space, more variability
- /ə/: relatively high F1 ([ʌ]-like)
- /ʊ/: spectral overlap with /o/ and /ə/



Speaker HM

- Post hoc results

- Normalized F1

- All vowel pairs significantly different except /e o/, /e ʊ/, /o ʊ/

- Normalized F2

- All vowel pairs significantly different except /a ə/

🔊 [vav aʙsq^hat] ‘I bought food’

🔊 [jəʔq^eθ] ‘he’s munching it’

🔊 [sətəŋəʔq^hət] ‘ask me’

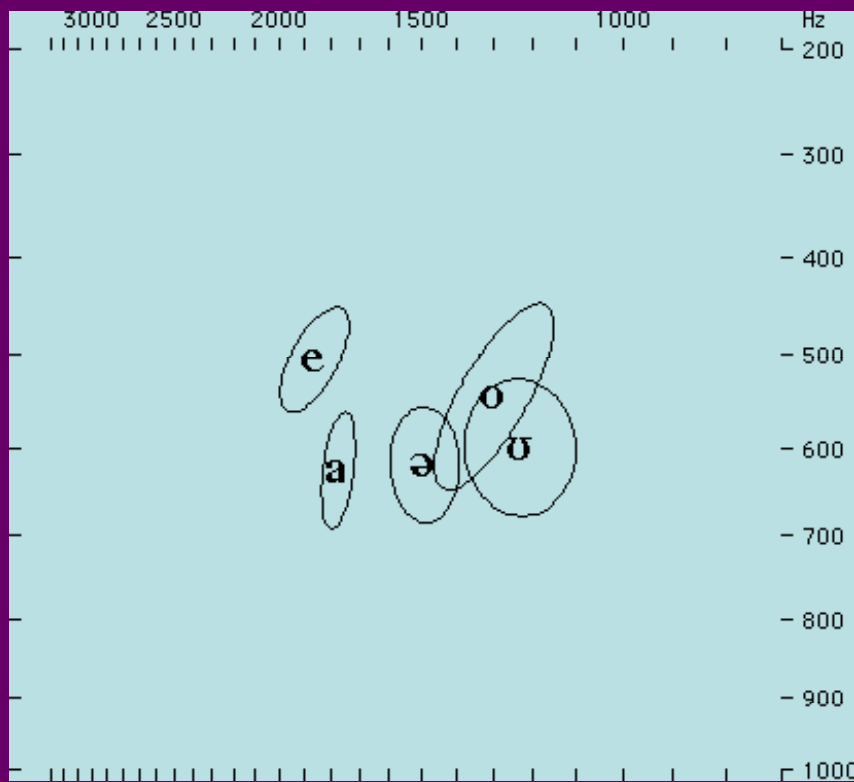
🔊 [nəgəχənəʙeq^hot] ‘it (house) collapsed’

🔊 [vankəŋəʔq^hut] ‘patch it’

- Alveolar__uvular

- /ə/: relatively high F1 (impressionistically [ʌ] in this context)

F2 – /ʊ/: relatively high F1, spectral overlap with /o/



Speaker HM

- Post hoc results

- Normalized F1

- All vowel pairs significantly different except /a ə/, /e o/, /e u/, /o u/

- Normalized F2

- All vowel pairs significantly different except /o u/

F1



[tʰaG] ‘no good’



[ʰeɔj] ‘puppy’



[kəʰəq] ‘one’



[qʰʊθ təseloq] ‘I have a cold’



[tətʰʊq] ‘it’s baggy’

Spectral properties summary

	__alveolar	__retroflex	__uvular
alveolar__	G1: e = o G2: e = ə	G1: e = o, e = ə, ə = o G2: a = o, e = ə	G1: a = ə, e = o, e = u, o = u G2: o = u
retroflex__	G1: e = o, e = ə, ə = o		
uvular__	G1: e = o, e = u, o = u G2: a = ə		

G1 = normalized F1; G2 = normalized F2

‘=’: ‘not significantly different’

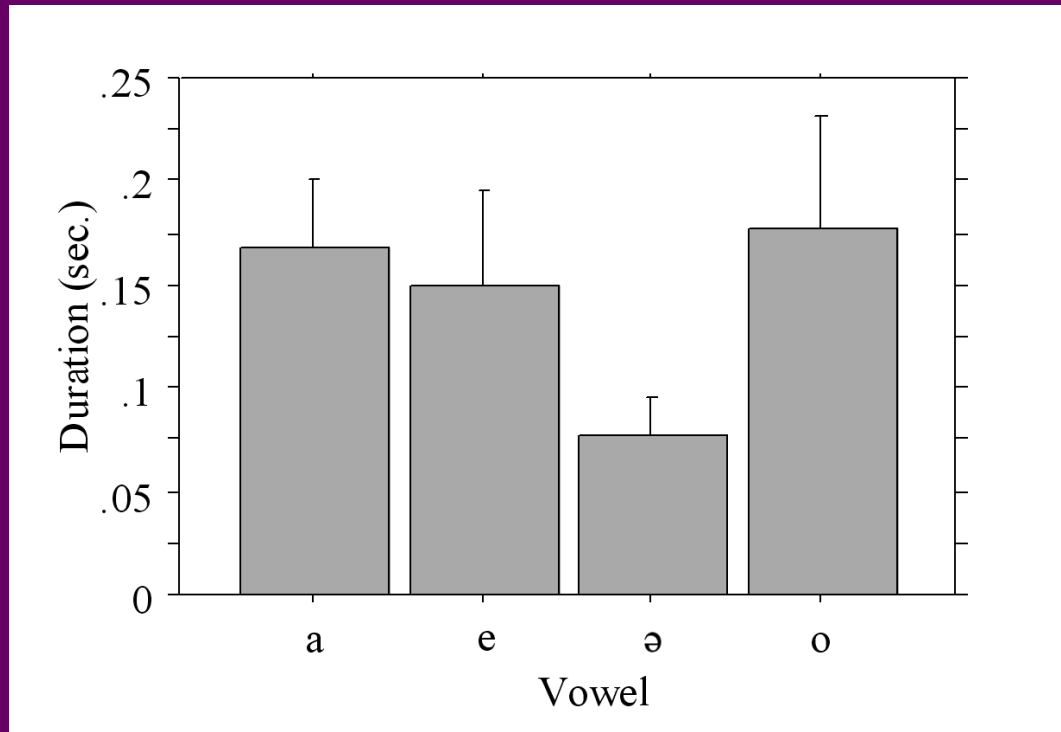
Spectral trends in Deg Xinag vowels

- Fewer significant differences before retroflex consonants than after
 - no significant differences in normalized F1 or F2 for /e ə/
- Fewer significant differences before uvular consonants than after
 - no significant differences in normalized F1 or F2 for /o ʊ/

Vowel duration studies

- Next slides present data averaged across 8 speakers
- In tables, () represents one standard deviation
- In bar graphs, error bars represent one standard deviation

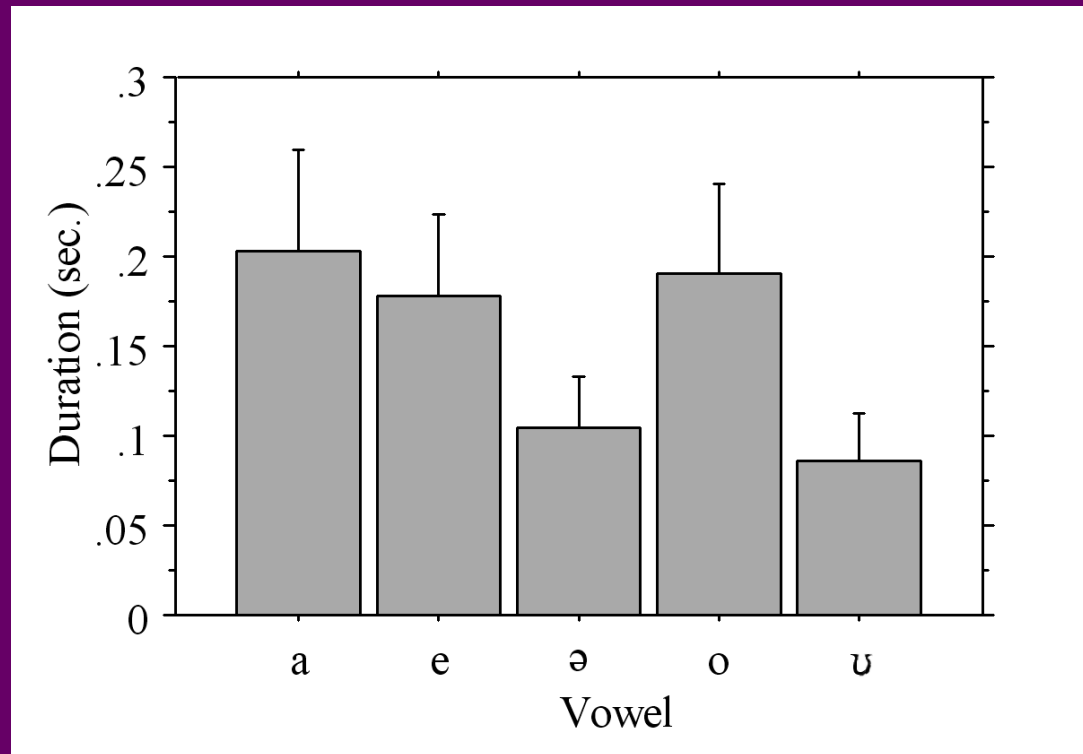
- Alveolar alveolar



a	e	ə	o
.168 (.0154)	.150 (.0278)	.077 (.0080)	.176 (.0140)

- Significant differences in length ($F[7,21] = 21.455, p < .0001$)
 - /ə/ significantly shorter than each of /e o a/ ($p < .0001$)
 - /e o a/ do not differ in length from each other

- Uvular _____ alveolar



a	e	ə	o	u
.203 (.0169)	.178 (.0195)	.105 (.0127)	.191 (.0089)	.088 (.0108)

- Significant differences in length ($F[7,28] = 34.633, p < .0001$)
 - Each of /ə u/ significantly shorter than each of /e o a/ ($p < .0001$)
 - /e o a/ do not differ in length from each other
 - /ə u/ do not differ in length from each other

Points of interest in Deg Xinag vowel system

Centralization of DX vowels before retroflex



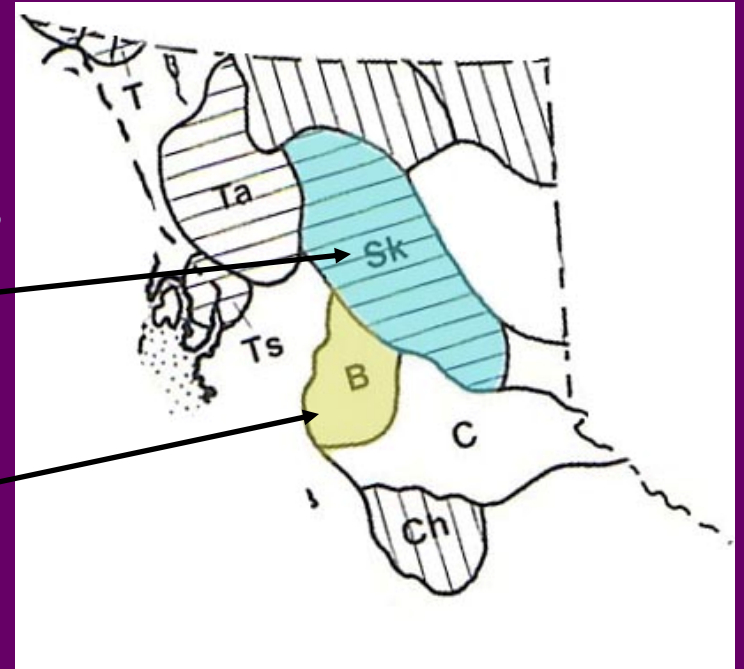
•Cf. sound change in Upper Tanana

–PA *a:, ə > UT /ɤ/
 *e: — ɛ > /ia/
 *u: > /io/

Reconstructed PA vowel system: Krauss, Michael (1964) Proto-Athapaskan-Eyak and the Problem of Na-Dene I: The Phonology. *IJAL* 30: 118-131.

Vowel duration

- Deg Xinag
 - Three long vowels: /e a o/
 - Two short vowels: /ə ʊ/
- Cf. other Athabaskan languages
 - Tsek'ene (Hargus in prep.)
 - long vowels: /e a o u/
 - short vowels: /ə ɪ ʊ/
 - Witsuwit'en (Hargus 2007)
 - long vowels: /i e ε a o u/
 - short vowel: /ə/
- Support durational differences between PA 'full' vs. 'reduced' vowels



Hargus, Sharon (2007) *Witsuwit'en Grammar: Phonetics, Phonology, Morphology*. Vancouver: UBC Press.

Hargus, Sharon (in prep.) *Kwadacha (Fort Ware Sekani) Grammar*. Seattle, Ms.

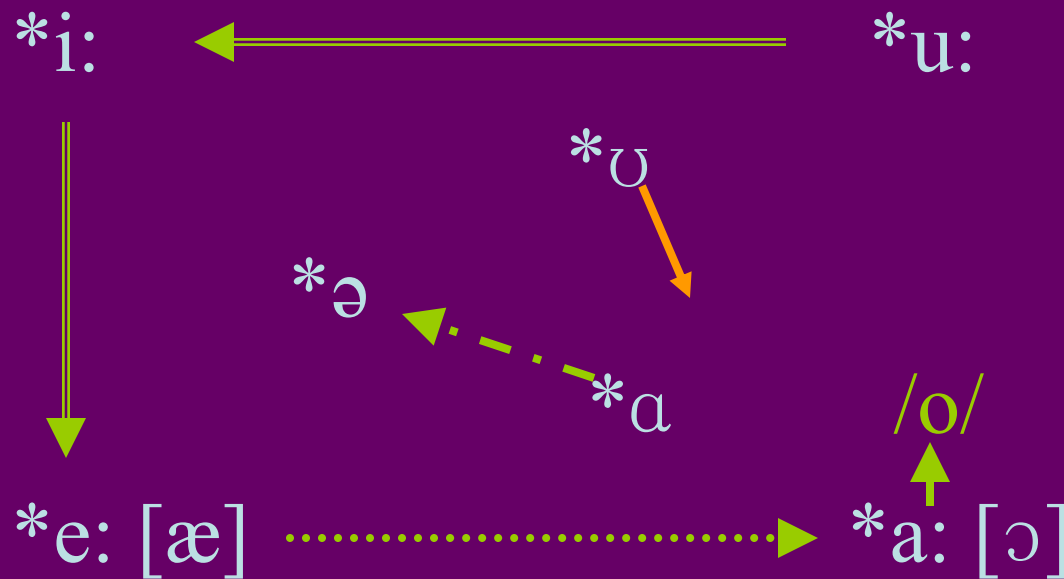
Detail of map from: Krauss, Michael (2005) *Athabaskan Tone*. In Hargus and Rice, eds. *Athabaskan Prosody*. Amsterdam: John Benjamins. 55-136.

No high vowel phonemes in DX

- /ʊ/ not a high vowel
 - Spectral overlap between DX /ʊ o/
 - Durational differences may crucially distinguish these vowels, particularly before uvulars
- DX uniquely without high vowels in Athabaskan?

History of DX vowel system

- Leer 1979: “counter-clockwise” rotation of PA ‘full’ (long) vowels > DX



Leer, Jeff (1979) Proto-Athabaskan Verb Stem Variation: I. Phonology. Fairbanks: Alaska Native Language Center, UAF.

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These slides will be posted at <http://faculty.washington.edu/sharon/>