

TECHNICAL REPORT: REGIONAL GEOLOGY AND TECTONICS  
Resume

Huachon Project, Cerro de Pasco departments, Peru



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## 1. INTRODUCTION

GPM Metals Peru, in its portfolio of generating new economic projects related to mining have a two-fold purpose for its main project (Pasco Gold claims) in Pasco Region. The first involves the exploration of Pb-Zn-Ag ore bodies around Pasco province, and the second has to do with the geological mapping into its claims. For this latter, the current regional works have demanded the review the preexisting regional geology. Whose lithology involves the existence of units serving as host for polymetallic deposits, such as the sedimentary succession of Mitu Group (Permian-Triassic) and Pucara Group (Upper Triassic-Lower Jurassic). Especially the ones which are emplaced into limestones from Pucara Group; having the best examples in Cerro de Pasco open pit, Atacocha, Machcan, San Gregorio and Shalipayco mines.

Pasco Gold claims have its property in the outskirts and in the northwestern part of Huachon County (Huachon Project), located ~33km towards the east of Cerro de Pasco; between Huanuco and Pasco departments in the Peruvian Central Andes. In these mountain ranges, known as the Eastern Cordillera, the exploration has been classically carried out seeking polymetallic ore bodies that may contain important values of silver, zinc, copper and lead; being the best examples Atacocha, Milpo and San Miguel mines. But, a very important thing about this region is that such mining districts are situated over a great structural system belonging to the Andean Belt Fault System. At first glance, either taking into account geological maps of Peruvian Geological Survey (INGEMMET) or any other previous mapping, such system seems to be simplistic. Since regional faults are very prone to be recognized through satellite images or because they are easily to find out due to lineations next to long patterns of folding suggest such geometry. So, this faulting architecture is very generalized and it does not actually work for punctual locations. Other relevant topic is that classical mapping has neither recognized the intrusions and subvolcanic bodies near and along the traces of the mentioned structural systems; nor put enough attention to the influence of smaller structures (e.g. tensional veins, normal faults or open fractures) that clearly has to do with mineralization in this region.

By this, our attempts have shown such great structural systems comprehend several faults and folds (of andean an antiandean orientation) that outcrop in the surroundings of Huachon (Huachon Project). And they are part of a NW-SE corridor represented by

various thrusts, strike-slip faults as well as local normal faults. This entire structural array is called here as the Chaska Fault and its northern prolongation towards the limits of Huanuco and Pasco departments it is then regarded as the Corralcancha Fault.

The fact of having a mineralized sedimentary strata related to a complex structural framework makes the Huachon Project an interesting site of investigation for mineral exploration. And this is logical due they are both the result of the Andean style of deformation. Whereby our procedures have been focused in field work with emphasis in the remapping of lithological/structural patterns besides the posterior structural analysis of faulting/folding. In order to know the integrated tectono-economic framework from the geographical space among Cerro de Pasco and Huachon counties. That for a last stage, it will allow us to construct a geological model that might be suitable to our needs.

## **2. GEOLOGICAL SETTING**

From Cerro de Pasco until Huachon, three geographical domains can be contrasted in function of the prevailing tectonics. The first one corresponds to the Mesozoic Fold and Thrust Belt where the major units are the Pucara Group (Upper Triassic-Lower Jurassic) and Goyllarisquizga Groups (Upper Jurassic-Lower Cretaceous); whose folded configuration is controlled by Tíclacayan Fault. In turn, this folded area is in faulted contact and separated through an unconformity from the second domain: the Marañon Metamorphic Complex (Neoproterozoic). With large outcrops that extend from Corralcancha to Chipa County. While the third domain is located at the northeastern part of the second domain, where previous works have mapped the Paucartambo/Ayancocha Granite (Paleozoic?). Nevertheless, such granite has a not very clear age due to its outcrops cut Pucara Group limestones through high-angle walls in the surroundings of Huachon Project. And around here, it is possible to observe volcano-sedimentary rocks from Mitu Group (Permian Triassic) intruded by granites and subvolcanic bodies which have been previously regarded as part of Paucartambo/Ayancocha Granite. Since these aspects had not been reported before, it is more convenient to consider those granites have an age younger than Lower Jurassic. For this reason, in this report the Paucartambo/Ayancocha Granite will just be named by its classical denomination. In terms of the previous described, the Huachon Project is located between the second and the third domain (Fig.1).

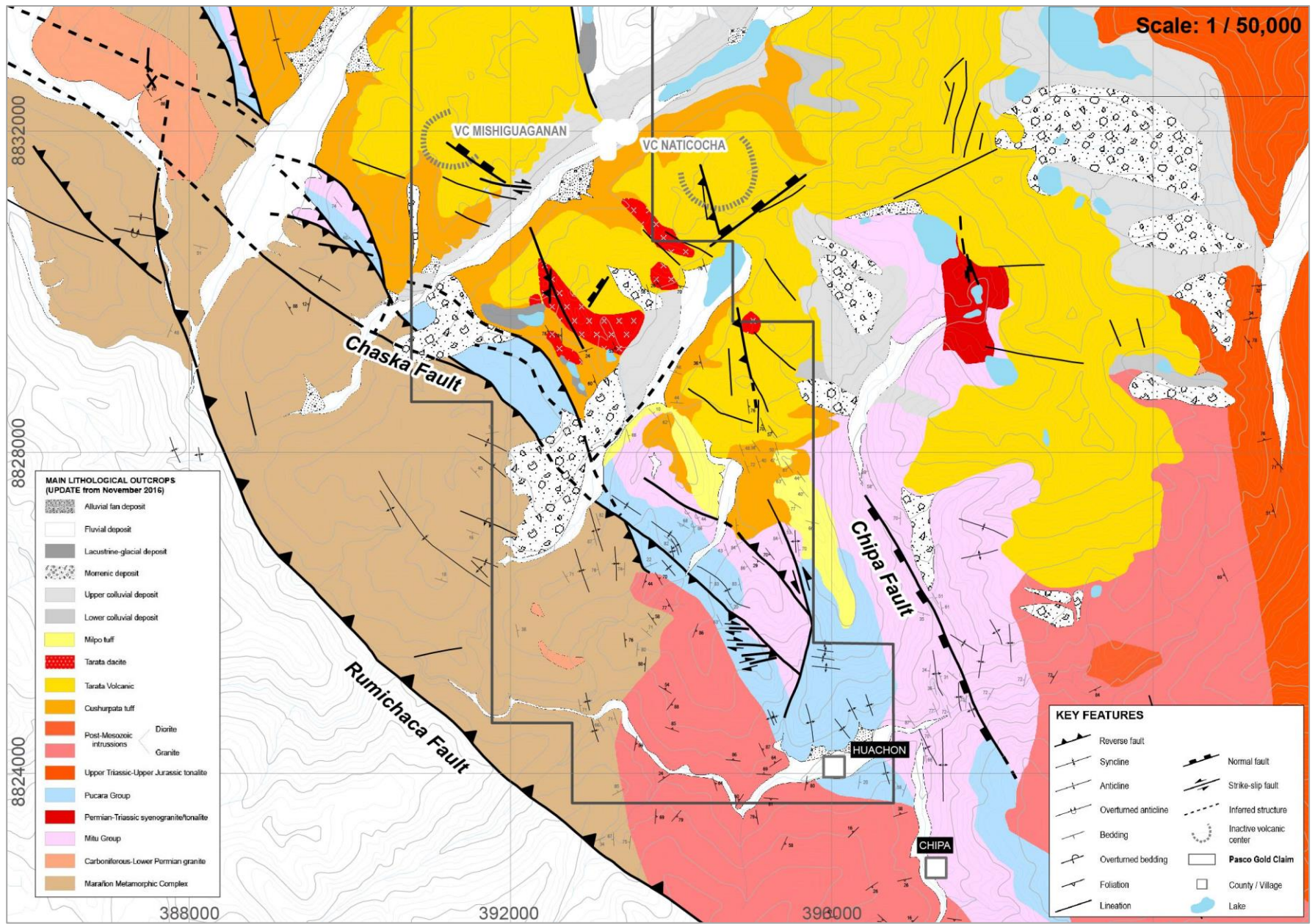


Figure 1. Geological map at 1/50,000 scale crafted for this report.

Beyond the chronological hindrances exposed before. The stratigraphy and magmatic pulses order are certainly quite different from the known Peruvian cartography for this region; although some pre-established facts are still valid: Marañon Metamorphic Complex underlies in angular unconformity to Mitu Group, and this unit is also below the Pucara Group. For instance, as there are welded ignimbrites that overlie to Mitu and Pucara Groups through angular unconformities, so that non-formal nomenclature has been necessary to use as it follows (Fig. 2):

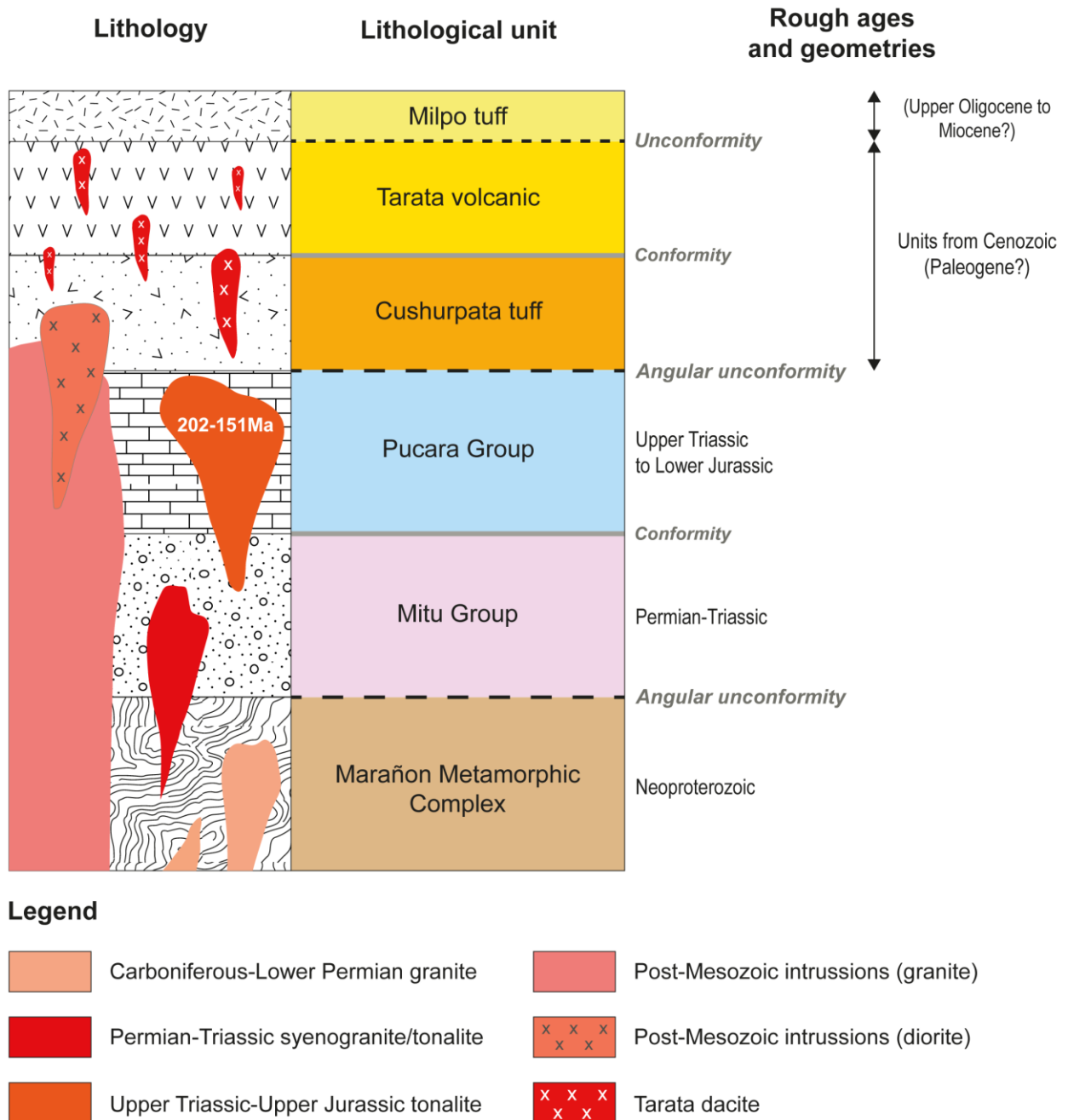


Figure 2. Stratigraphy and igneous rocks of Huachon Project. This area features a series of magmatic pulses that took place from Paleozoic to Cenozoic times.

### 3. FIELD OBSERVATIONS AND MAPPING

To sum up all the observations made during the field work, it is convenient to show the gathered information as follows:

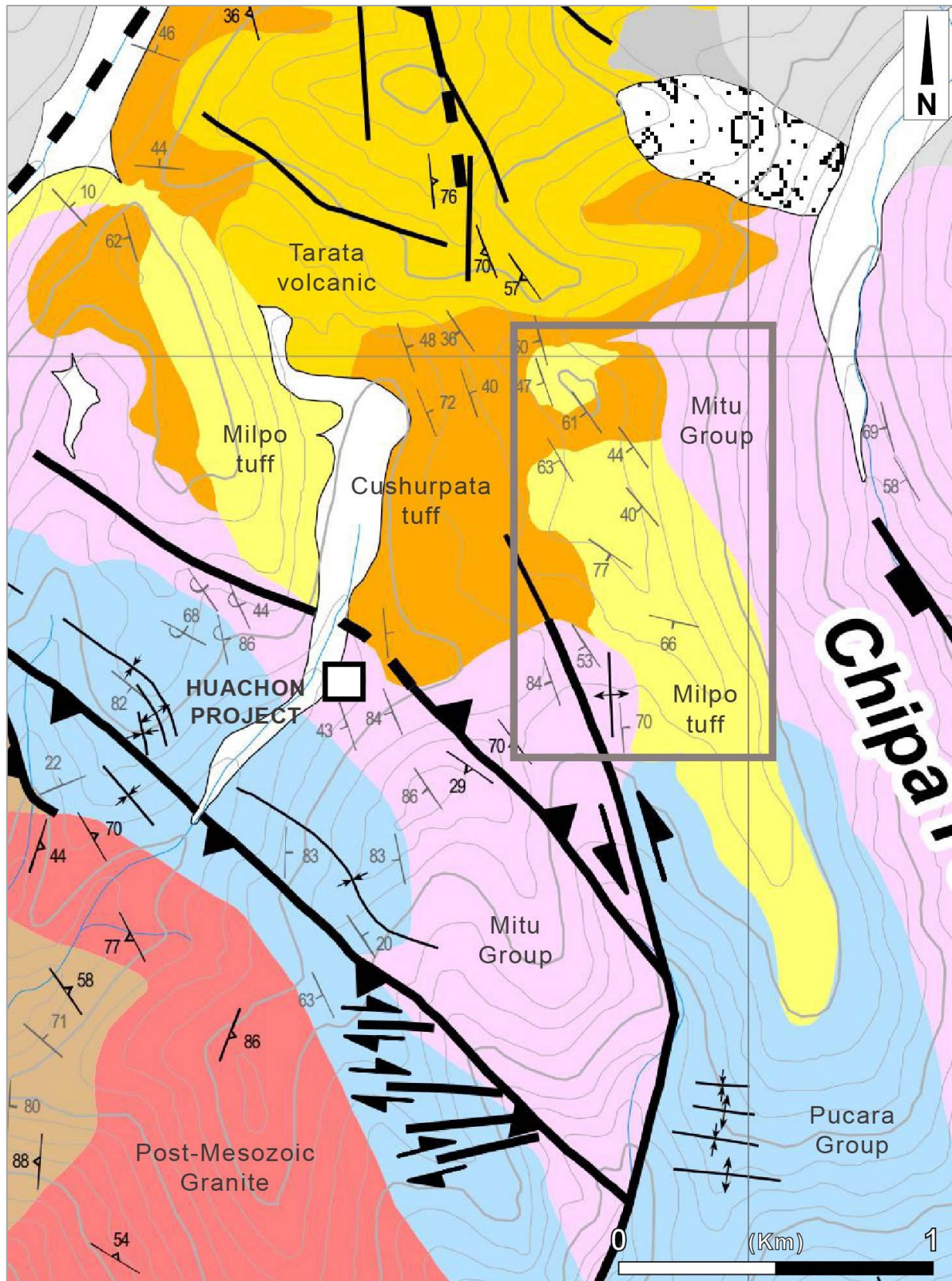


Figure 3. Geological map indicating the location of Milpo tuff.



Figure 4. Milpo tuff outcrops around the road that leads to the core of Huachon Project.

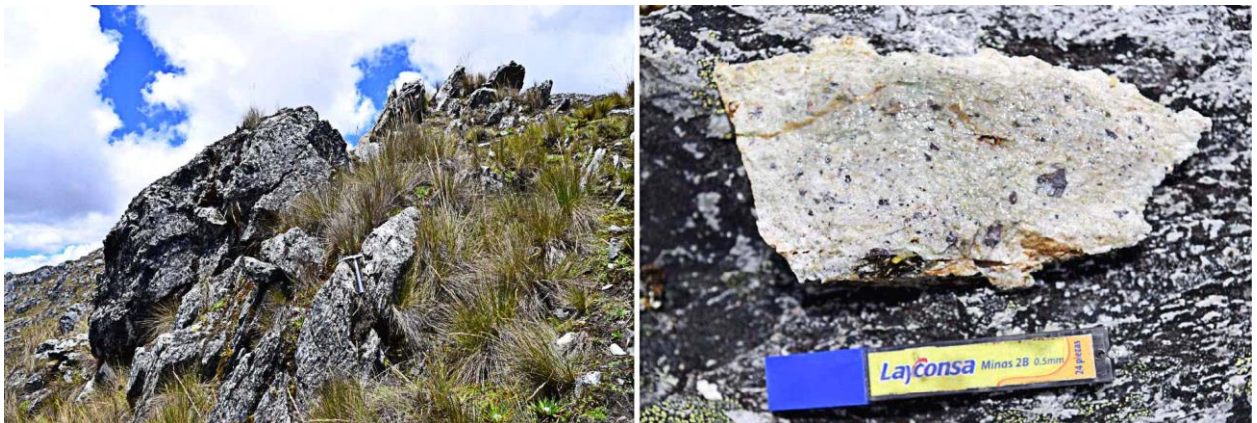


Figure 5. Milpo tuff whose outcrops are foliated by its closeness to the NW-SE sinistral fault that appears northeastwards from Huachon Project (see figure 3). Here, lithology is mainly characterized by silicified welded ignimbrites.



Figure 6. Foliated outcrop of Milpo tuff composed by silicified welded ignimbrites.

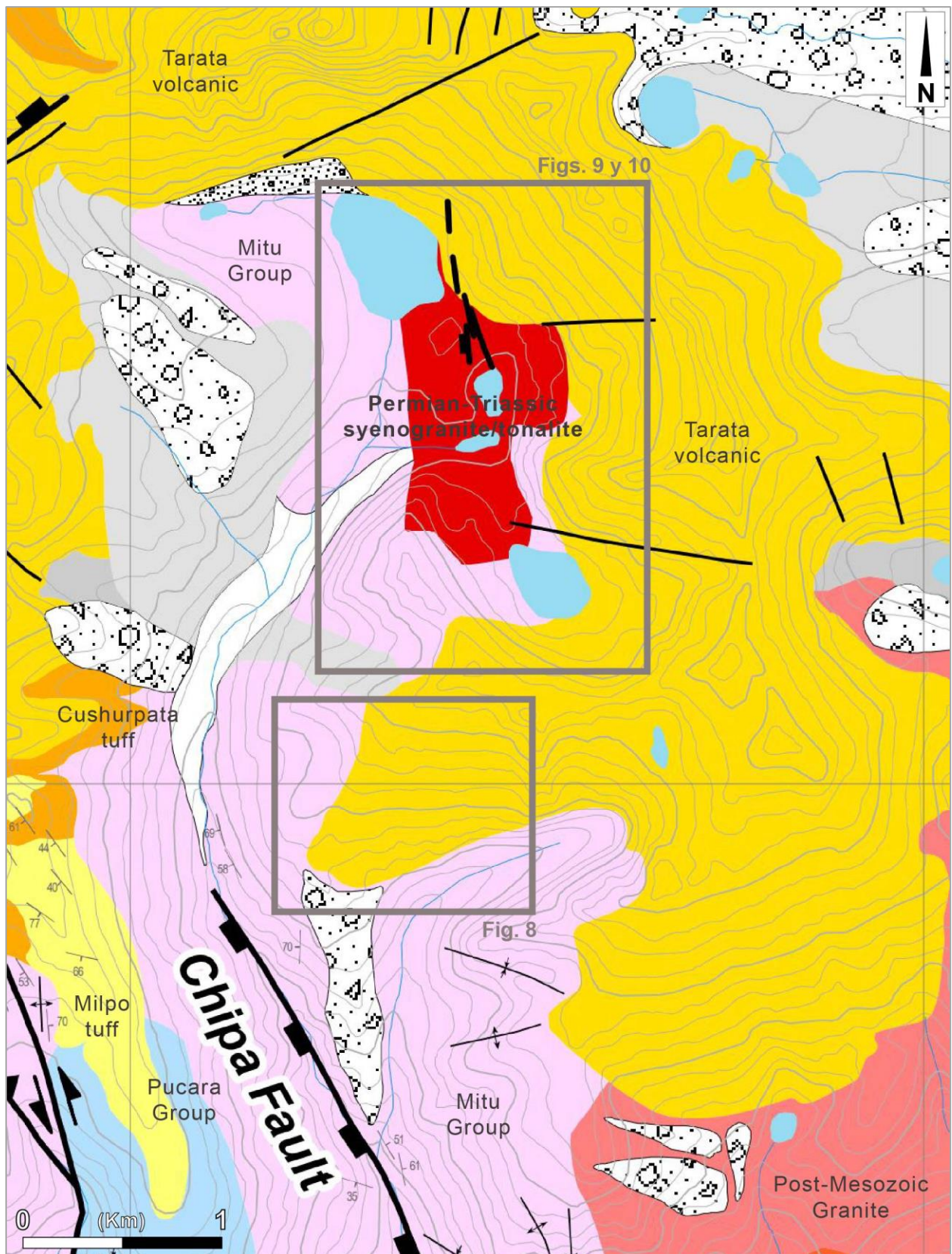


Figure 7. Geological map indicating the location of the emplacement of Tarata volcanic and Permian-Triassic syenogranites/tonalites over and into the Mitu Group, respectively.





Figure 8. Tarata volcanic overlying the Mitu Group along the road that connects Huachon county to Huachon Project.



Figure 9. Tara volcanic overlying Mitu Group and Permian-Triassic syenogranites/tonalites.



Figure 10. Outcrop of the Permian-Triassic syenogranites/tonalites. This intrusion is only present into the Mitu Group strata.

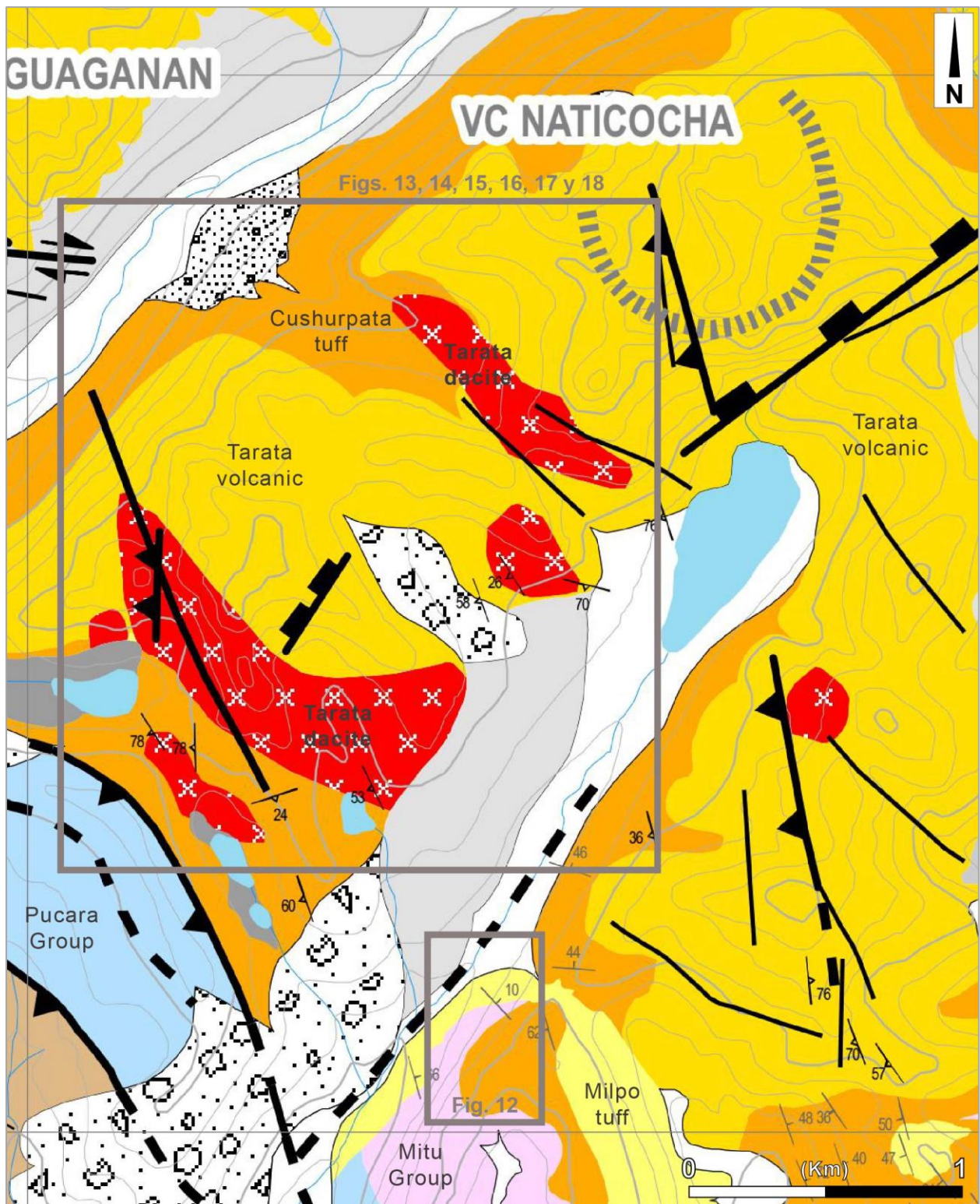


Figure 11. Geological map with the detail of the emplacement of Cushurpata tuff over the folded Mitu Group. Upwards, it is possible to see that several intrusions by dacites (Tarata dacite) affect to Cushurpata tuff and Tarata volcanic. The name "VC Naticocha" refers to concentric structures where strong foliations and dacytic compositions suggest the present of extinct volcanic centers. This latter structures are cut by NW-SE reverse faults and NE-SW normal faults that are parallel to tensional veins.



Figure 12. The center white continuous line indicated the unconformity between Cushurpata tuff and Mitu Group.

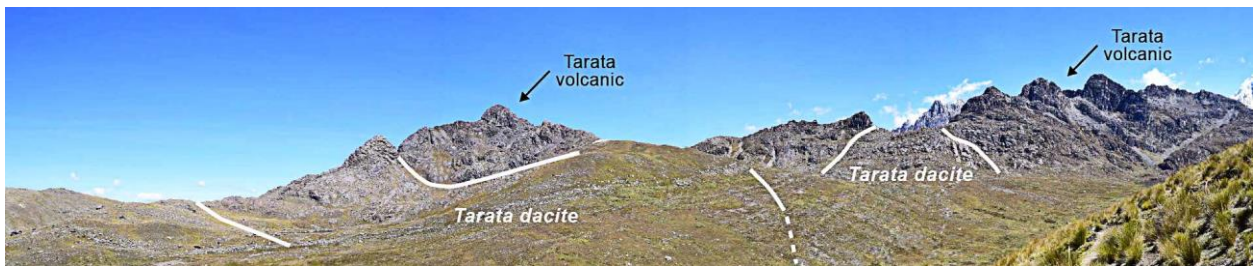


Figure 13. Intrusions of dacite (Tarata dacite) into the welded ignimbrites of Tarata volcanic.

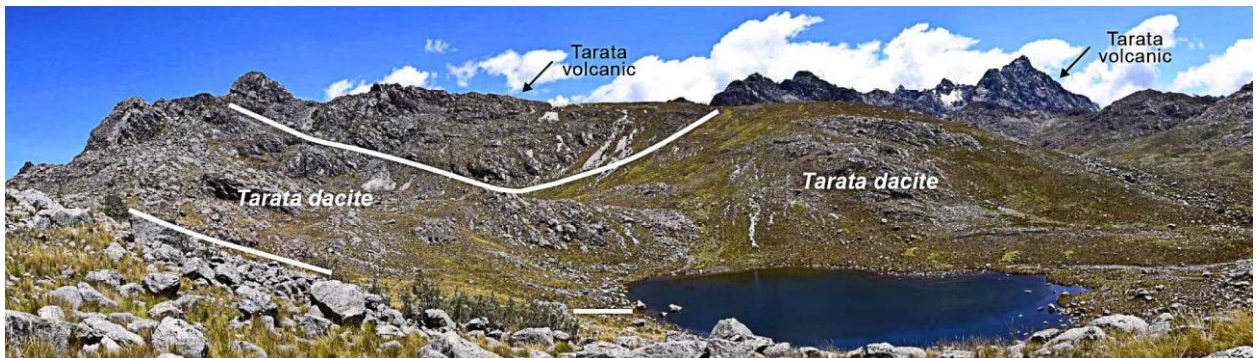


Figure 14. Planar contacts between the walls of Tarata dacite in contact to Tarata volcanic.



Figure 15. Outcrops of Tarata volcanic. They are mainly composed by welded ignimbrites, but they really correspond to andesites with fine porphyric texture that correspond to subvolcanic bodies that are previous to the intrusions of Tarata dacite.

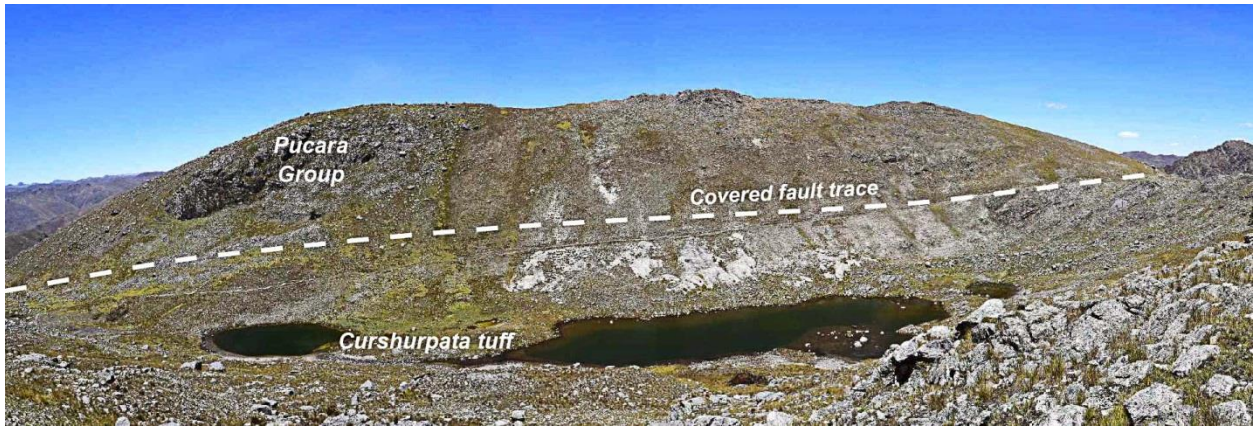


Figure 16. SE-NW view from a covered fault trace that correspond to the reverse fault responsible of the thrust of Pucara Group over the Cushurpata tuff.



Figure 17. Welded ignimbrite from Cushurpata tuff.



Figure 18. Planar intrusion of Tarata dacite into the Cushurpata tuff.

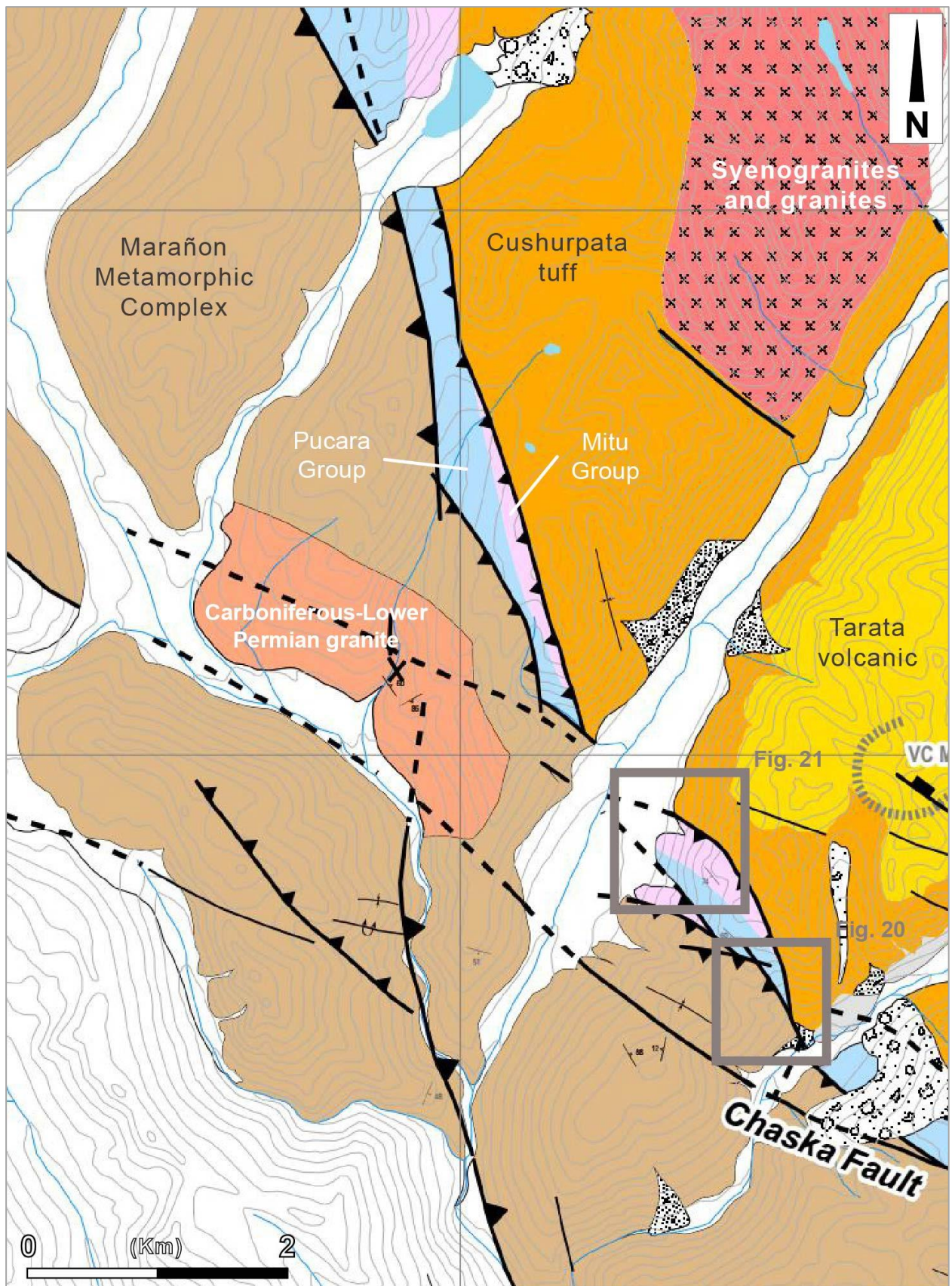


Figure 19. Geological map indicating the location of some of the reverse faults that are part of the Chaska Fault.

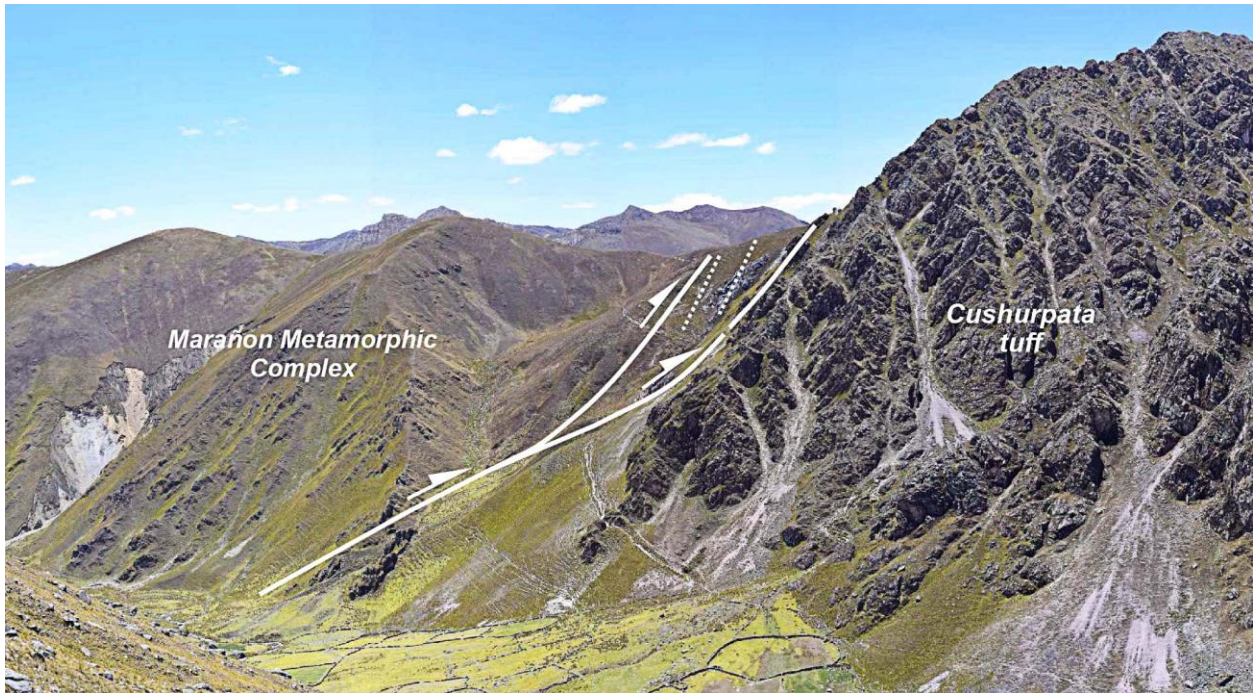


Figure 20. SW-NE view of a reverse fault as the result of the thrust of Marañon Metamorphic Complex over the welded ignimbrites of Cushurpata tuff.

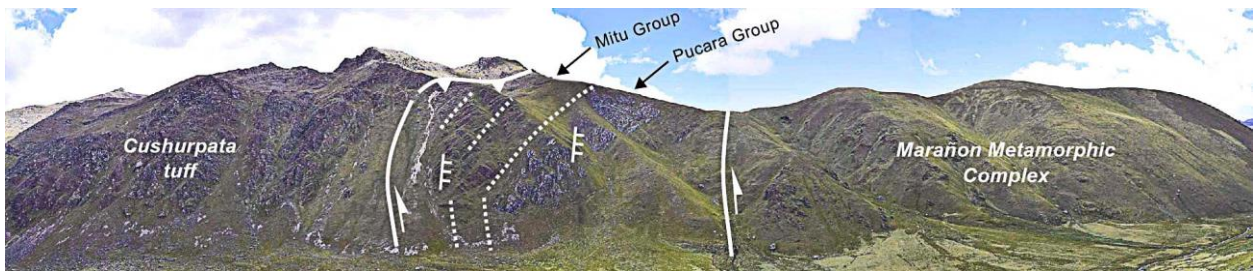


Figure 21. NE-SW view of the reverse fault from figure 20 but seen from its opposite side. The high angle bedding of Mitu and Pucara Groups remark the deformation grade that occurs along the thrust of the Marañon Metamorphic Complex.

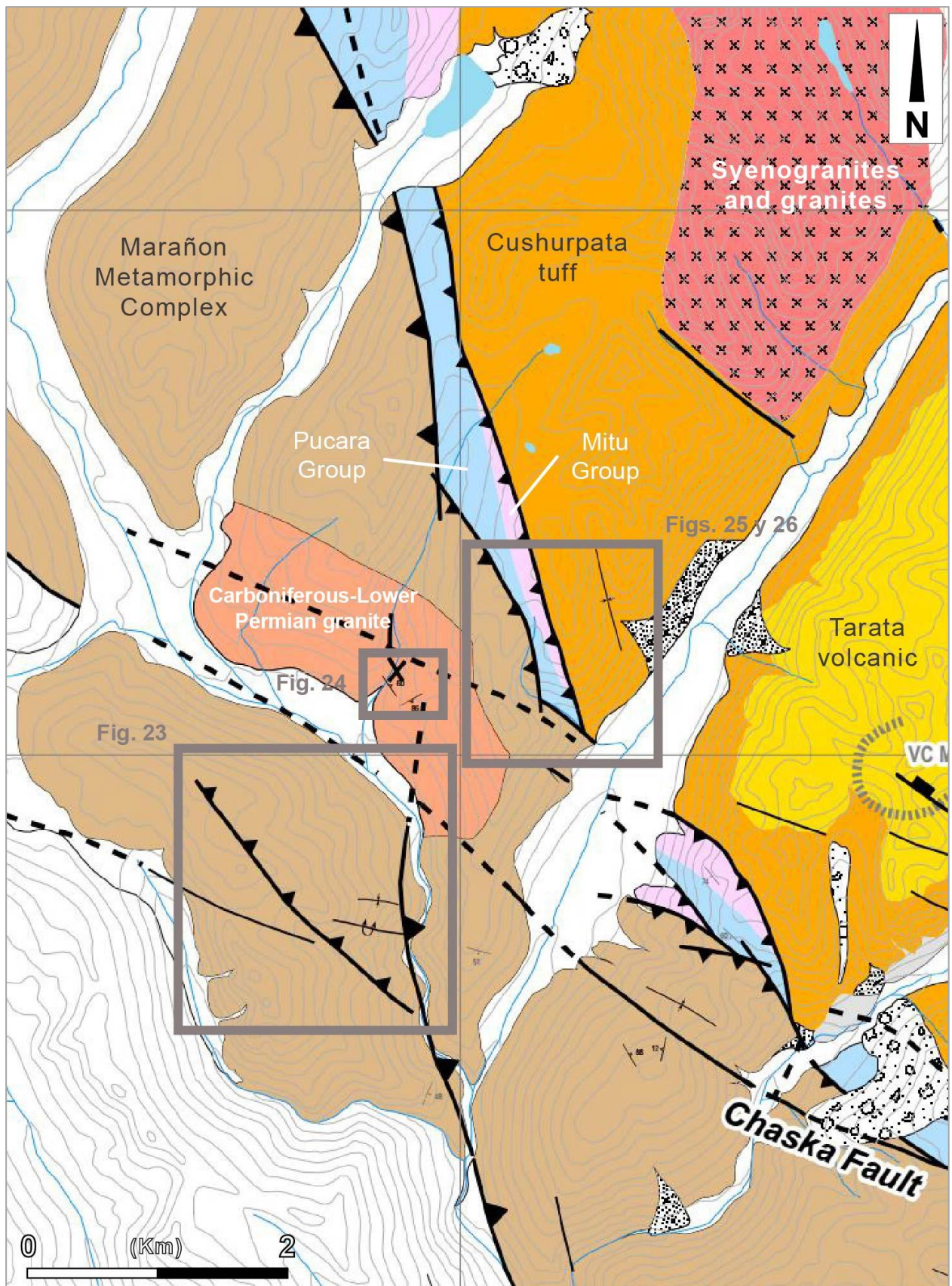


Figure 22. Geological map indicating the presence of reverse faults into the Metamorphic Marañón Complex, which in turn represents an external part of the Chaska Fault. Besides, it is possible to note that some other structures that involve the Mitu and Pucara Groups have similar orientations of Carboniferous-Lower Permian Granite.

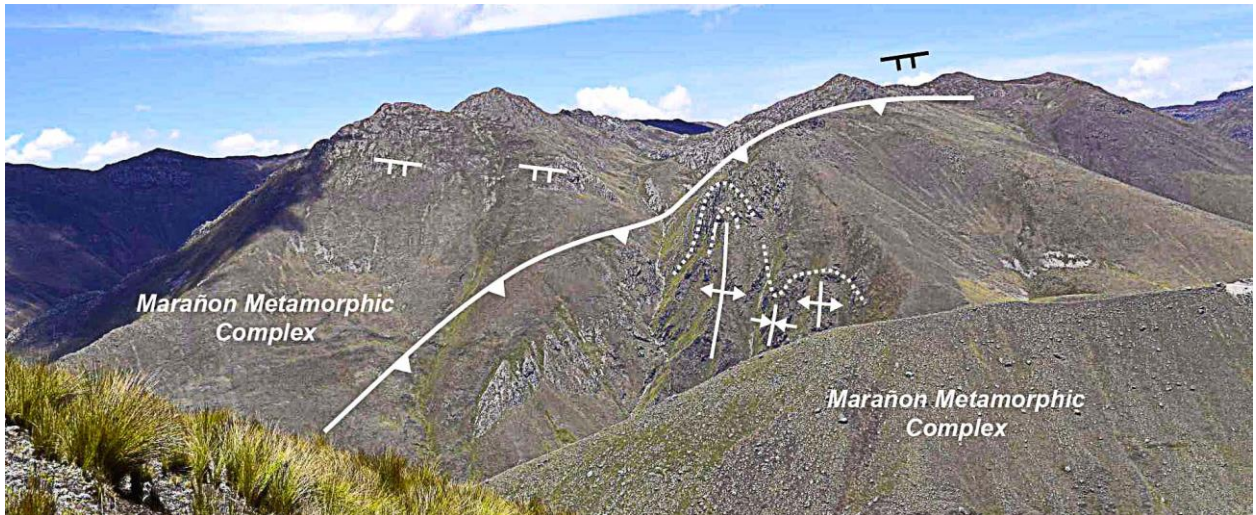


Figure 23. SE-NW view from a reverse fault into a very block belonging to the Marañon Metamorphic Complex. The hanging-wall block lifted by means of a folded system that are opposite to the strike of the bedding from the foot-wall block.



Figure 24. Outcrops from Carboniferous-Lower Permian Granite. These intrusions cut the Metamorphic Complex giving place to extensional and compressional structures.

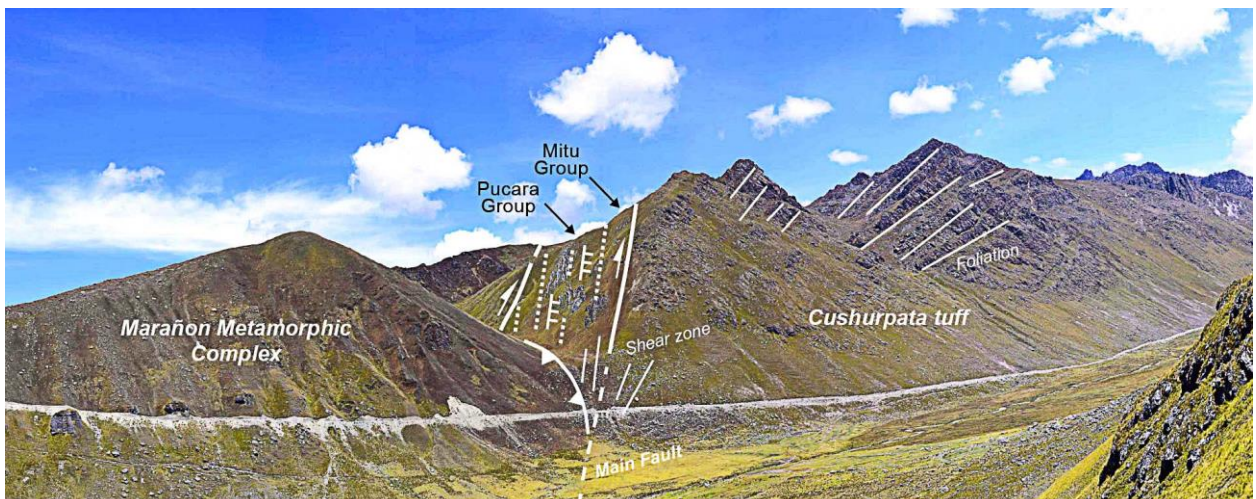


Figure 25. NE-SW view of a reverse fault that lifted the Marañon Metamorphic Complex over the Mitu-Pucara Groups and Cushurpata tuff. The main arguments to acknowledge this contact as a fault is the fact of having a high-angle wall in the middle of vertical strata.





Figure 26. Detail of the shear zone of the main fault seen in the figure 25. These outcrops correspond to high foliated phyllites from Marañon Metamorphic Complex and in turn they have intrusions of porphyric andesites along the walls of the shear zone.

#### 4. RECOMMENDATIONS

-To delve into the tectonics of the Cushurpata tuff and Tarata volcanic. In order to accomplish this, it is necessary to map their structures since in accordance to the mapping presented here. They can divide into mineralized veins and normal faults that are hard to detect by simple inspection or photogeology. This topic is important because of tensional structures preferentially match with the major gold-quartz veins systems such as the ones located in Minera Anadel S.A.C.

-To check out the granite intrusions (Carboniferous-Lower Permian) aimed to the search of microstructures over their outcrops. Due to such structures show evidences of contemporary kinematics respect to the genesis of tensional structures.

-To carry out the sampling of igneous rocks so as to get their ages by Ar/Ar chronology. To achieve this, it will be necessary to look for granites and tonalites that at least bear some biotite crystals. The final goal of this procedure will help to establish a correct and more accurate stratigraphy-sequence of events of magmatic pulses related or not to mineralized events.