

ACX: ACTIVE ACCLIMATIZATION EXPEDITION - CONTENT

ATACAMA

Atacama is a sand/shingle (sandy/stony) desert situated in northern Chile. Due to unique location between two mountain ranges – the Andes and Chilean Coastal Range, which limit the movement of humid air masses, it is considered the driest desert on Earth. In the Antofagasta Region precipitation does not exceed 1 mm annually, but there are areas where meteorological stations have never recorded any rainfall! Some scientists suggest that a number of old river beds have been dry for more than 120 thousand years! While it is not uncommon in the Atacama to encounter sizeable lakes or hot springs, they are usually salty or saturated with various minerals, which makes the water bitter and non-potable.

Lack of potable water, very dry air and high diurnal temperature variation exceeding 40 degrees Celsius are only some of the long list of nuisances that await the explorers venturing into that region. The hardship is magnified by the high altitude and low partial pressure of oxygen, as part of Atacama lies in the Altiplano – the second highest (after Tibet) mountain plateau in the world. The southern part of this volcanic plateau reaches 4500 meters above the sea level. Here, the highest peaks of Chile are situated. Most of them are the six-thousanders and the summit of the tallest of them – Ojos del Salado – reaches nearly 7000 meters a.s.l., which makes it the highest volcano in the world. The dry climate of the Atacama does not favour the creation of glaciers, even in the highest sections of the mountains. The only ice formations are the penitentes, which can reach up to several meters of height and may form vast fields, which are quite difficult to cross!

They can be encountered above 5 500 meters of altitude and are formed by intensive snow and ice melting by sunlight during the day and subsequent freezing during the night. This repeating process shapes the penitentes into a distinctive form, reminiscent of monks' hoods; their sharp tops inclined at 11 degrees of angle always point to the north. The melting water gathers in small depressions yielding small ponds and sometimes sizable lakes. Those are some of the only sources of fresh water in the Atacama, what's interesting is that they are the highest bodies of water in the world!

THE POLISH WRITE THE HISTORY

The history of South America has been profoundly impacted by the Polish people. One of the most luminous characters was Ignacy Domeyko, an accomplished geologist and mineralogist, who laid the cornerstone of the mining industry in Chile. For many years he was the rector of the Universidad de Chile, was instrumental in raising the profile of the university and spurred development of the intellectual circles of the country. Another Pole, Ernest Malinowski, was no less accomplished in his deeds – he was a war hero and the constructor of the world's highest (at that time) railway line - Ferrocarril Central Andino.

The Poles were also prominent in mountaineering and exploration of the Chilean Andes. During the 2nd Polish Andean Expedition in 1936-37 Polish climbers Justyn T. Wojsznis, Jan A. Szczepański, Witold H. Paryski, and Stefan Osiecki scaled as much

as eight six-thousanders for the first time ever, among them the highest – Ojos del Salado.

The last couple of years mark another type of successes of Poles in the Atacama, but this time... underwater! In 2015 a group of Polish scuba divers from MedExpeditions have made a pioneering exploration of the highest crater lake on Earth (5906 m a.s.l.) – unnamed body of water in the crater of Nevado Tres Cruces Norte, setting the world record in high altitude diving. This accomplishment was bested a year later by another Polish scuba diver, who beat the record by another 90 meters diving in the Cazadero lake.

ACCLIMATIZATION – WHAT IT IS AND WHY IT'S IMPORTANT

Acclimatization is an adaptation process, which help the organism to adjust to new climates. Acclimatization to high altitude is a process that helps the organism to adapt to progressively lower levels of oxygen partial pressure in the atmosphere by employing various physiological mechanisms. Mistakes in the process of acclimatization often lead to tissue asphyxiation (hypoxia) and result in symptoms of altitude sickness, among them headaches, dizziness, upset stomach and insomnia. Such symptoms may arise at the altitude of 2500 meters a.s.l., but there were instances when they appeared 1000 meters below that level! The best way to alleviate the symptoms is to descent while downplaying the symptoms and staying at high altitude may lead to accidents and complications detrimental to one's health. It is a common knowledge, nevertheless every year the altitude sickness is responsible for many deaths in the mountains. This is the reason why acclimatization is the key element to account for when exploring targets high above the sea level. While years of observation and mountaineering experience has led to universal acclimatization model, there are still some differences of opinions among the experts concerning certain aspects of it. Even today we do not know what's the best and safest way to climb the highest mountains.

ACX: ACTIVE ACCLIMATIZATION EXPEDITION – GAINING KNOWLEDGE AT THE TOP

The ACX expedition is not only the biggest mountain research project in the history of Poland, but also a unique project worldwide. It is the first attempt to compare different models of high altitude acclimatization and the first one that is performed in such an advanced manner. The goal of the expedition is to research different models of mountain acclimatization with regards to human health and performance at extreme altitudes. The researchers will be comparing the active acclimatization and standard acclimatization models. The former is the type of acclimatization whereby the climbers try to get to as high an altitude as possible during the day and then to return to the level to which the body is already accustomed. Standard acclimatization method involves continuous climbing and setting up intermediate camps. There will be over 40 participants in the expedition, among them a group of experts employed by Medical Universities, Academies of Physical Education and in the Polish Academy of Sciences. Eight members of the research group represent various fields of the sciences: cardiologists, anaesthesiologist, physiotherapist, dietician, biochemist and physiologist, who will collectively create an interdisciplinary team and will study the

phenomena of hypoxia and high altitude acclimatization. The researchers want to achieve the best results by integrating the knowledge and skills of all team members, starting from the most important part – the work out, diet, cardiological and physiological research and concluding with molecular research. The molecular tests will employ large-scale analyses: genomic, transcriptomic, proteomic and metabolomic. In other words, the molecular “pillars” that build us as living organisms will be analysed. Additionally, the changes in their composition due to increasing altitude will be researched as well as the way the changes interact with each other and how they correlate on the physiological, dietary and training level.

Dietary research will revolve around nutrition and changes in the digestive tract while in the mountains. Thanks to cooperation between medicine and dietary research the ACX scientists count to discover relationships that will not only help to understand the functioning of the organism while exerting in hypoxia, but will also be instrumental in creating new standards and recommendations concerning nutrition in the high mountains, which is an area that still needs further understanding. Passing this expertise on to the members of high mountain expeditions may improve the effectiveness of their sport endeavours as well as the quality of their experiences. The planned cardiological research will include qualitative and quantitative analysis of heart arrhythmias, electrocardiographic measurement of the repolarization of the heart muscle as well as echocardiographic assessment of its operation. Another area of research will deal with the activity of antioxidation enzymes, changes in the parameters of blood morphology and anomalies of acid-base balance in response to different mountain acclimatization styles. The expected result of all this effort will be to establish most efficient and safest way to acclimatize, which will avoid the development of acute mountain sickness and its complications, such as high-altitude cerebral edema. Another area that will be analysed is the level of exhaled nitrogen oxide as a factor that can, in a simple way, help to establish the risk of developing high-altitude pulmonary edema.

Such a complicated venture requires not only professional medical equipment, but also proper logistical effort. Organizing the transportation of people, food, water and supplies, setting up the camp with a kitchen, mess and ambulatory plus launching a professional laboratory at the altitude of over 5000m a.s.l. is a demanding challenge. This is the reason why the ACX team is supported by experts – members of last year’s Polish National Winter Expedition to K2 and members of MedExpeditions, who had organized two scientific expeditions to the area in 2012 and 2015.

OJOS DEL SALADO – WHY THERE?

Ojos del Salado, as a goal of our expedition, has been chosen for a reason. The base of the volcano is extensive, measures as much as 10 kilometres, while its foot lies at the altitude of 5200 meters. The terrain is of utmost importance, as the gentle slopes allow for the 4WD vehicles to reach almost 5900 meters. It is crucial, as the advanced research equipment is quite heavy and, without the off-road vehicles it would be impossible to deliver it to such great heights. Therefore, it is the only place in the world, where medical research can be performed at such a high altitude. Additionally, Ojos del Salado is a relatively easy mountain, as only the last couple of dozen meters of ascent require rock climbing experience. It is also devoid of glaciers

and snow cover is rarely encountered in the summer, which greatly reduces the risk of natural hazards.

The data gathered during the expedition should assist in better diagnostics, prophylaxis and treatment of acute mountain sickness. Based on the research, formation of new set of standards for acclimatization planning will be attempted. The organizers would like to create a new chapter in the mountain medicine and physiology while the knowledge and experience gathered will improve the safety and positively impact sport achievements in the high mountains. The scientists believe, that the research will help not only the climbers in the highest mountains, but can also assist the athletes, coaches, dieticians and medical doctors in their daily work.