Hypoxic Training:

The physiological adaptations due to training in hypoxic environments can be broken down into three categories, endurance adaptations, cardiovascular adaptations, and muscular adaptations. Within athletics research has mainly looked at the endurance and muscular adaptations to hypoxia.
**Endurance Adaptations:**

Training in high altitudes stimulates the production of erythropoietin from the kidneys (Etheridge T 2011). Erythropoietin travels to the bone marrow to stimulate the production of red blood cells to increase hemoglobin saturation and as a result oxygen delivery. Research has found that there are various levels at which this adaptation takes place (Humberstone-Gough CE 2013). Some individuals have seen great adaptations to altitude training and others have seen little to no gain in red blood cell count (Shen G 2013).
Illegal Erythropoietin Use:

Over the past few decades there has been an increase in the illegal use of synthetic erythropoietin. This illegal use, called Blood Doping, is done in order to gain the same effects of endurance training at high altitudes by increasing the red blood cell count in the body. The increased red blood cell count then increases the ability to carry oxygen in the blood to deliver it to the working muscles (Etheridge T 2011).
Oxidative Capacity:

Other adaptations that help to increase an athlete's endurance performance relate to the increased oxidative capacity due to increased capillary density and myoglobin concentration. These increases allow more oxygen to reach the skeletal muscle to be used during exercise. But this adaptation has had
conflicting reviews. Some research has found capillary density to increase while other research has found no increase in the density at all (Hoppeler H 2001).

**Muscular Adaptations:**

Muscular adaptations have the most controversial evidence to hypoxic training. A study done on expeditions to the Himalayas found that there was a loss in body mass, mainly in mostly muscle volume. The cross-sectional area of the muscle was seen to decrease through this study (Hoppeler H 2001). The loss in muscle mass was attributed to high altitude and not malabsorption.

Other limitations that have been found with hypoxic training are found in the oxidative capacity of muscles. Research has found a reduction of oxidative capacity in the bodies muscles with acute exposure to altitude (Etheridge T 2011). With these changes in oxidative capacity damage to the muscle tissue has also been found with altitude training. The muscle degradation product lipofuscin has been found at high levels with high altitude training (Hoppeler H 2001). This product is formed by the peroxidation of lipids and is indicative of muscle fiber damage (Etheridge T 2011).

Positive adaptations to hypoxia in the skeletal muscle has been found in acute exposures to high altitude. The live low and train high theory has been supported for the benefits of a larger capacity for oxygen use and delivery to the skeletal muscle tissue. Acute exposure to altitude with endurance training has found significant increases in both muscle oxidative capacity and capillary density to improve oxygen use.
This picture shows the accumulations of the degradation product lipofuscin (lf). This increase in lf shows where the muscle tissue is damaged.