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How much? How deep? How often? Parameterizing explosive gas release during Strombolian activity

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Strombolian explosive activity is often described as the simple bursting of individual, large gas bubbles at the surface of a stagnant magma column or lake. However, individual explosions at Stromboli volcano often last up to several tens of seconds and produce complex geophysical signals, and large uncertainties still exist on the timing, pressure, depth, and volume of gas release during an explosion. High-speed imaging already proved capable to capture complex patterns within individual explosions, revealing velocity and mass fluctuations in the ejected pyroclasts flux. In particular, here we evidence the presence of multiple jets of pyroclasts within each explosion. The jets, sometimes visually correlated with individual bubble bursting, consist of the fast release of well-collimated pyroclasts, lasting from a few milliseconds to a few seconds, and being characterized by exponentially-decreasing velocity of pyroclasts progressively erupted. Shock-tube experiments successfully reproduce such jets by the impulsive release of pressurized gas-particles mixtures, and are used to calibrate a model that describes the maximum velocity and velocity decay in the jets as a function of the pressure, volume, and depth of the pressurized mixture. Application of the model to Strombolian activity at Stromboli volcano allows, for the first time, a definition of the number, frequency, timing, pressure, volume, and depth of the individual gas release events produced during a single explosion. Release depth and volume within an explosion follow variable trends for different erupting craters, but seems to decrease with time for the more intense explosions, suggesting gradual refill of the conduit even in the short time span of an individual blast.